“A STUDY ON TIRADS CLASSIFICATION SYSTEM IN THE RISK STRATIFICATION OF THYROID SWELLINGS”

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in partial fulfilment of the requirements for the degree of

M.S. in

GENERAL SURGERY, APRIL - 2016

Department of Surgery

Tirunelveli Medical College & Hospital

Tirunelveli-11

CERTIFICATES

DECLARATION BY THE CANDIDATE

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2.	Study Protocol	☑
3.	Department Research Committee Approval	☑
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5.	Investigator's Brochure	☐
6.	Proposed Methods for Patient Accrual Proposed	☑
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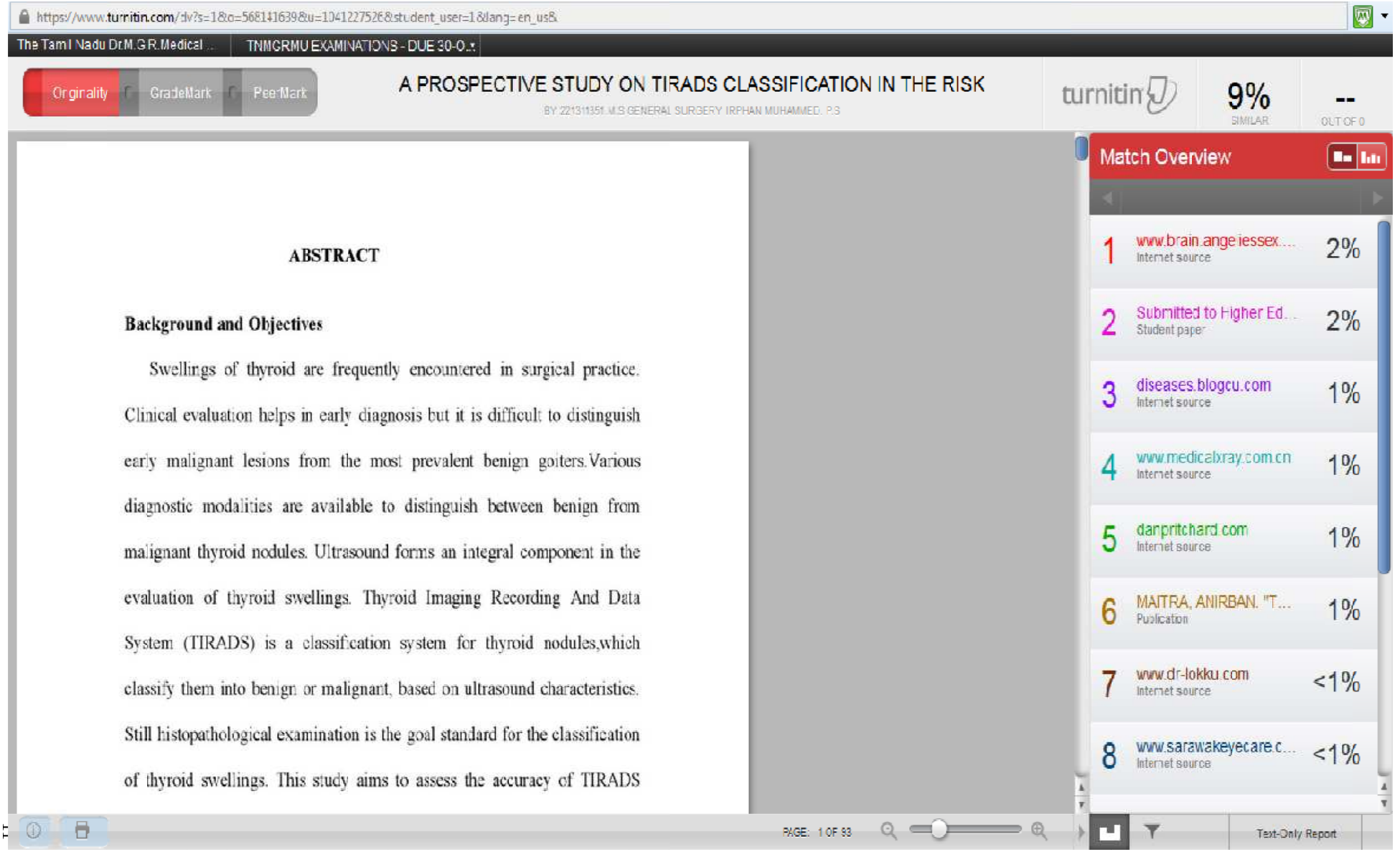
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ABSTRACT
Background and Objectives
Swellings of thyroid are frequently encountered in surgical practice. Clinical evaluation helps in early diagnosis but it is difficult to distinguish early malignant lesions from the most prevalent benign goiters. Various diagnostic modalities are available to distinguish between benign from malignant thyroid nodules. Ultrasound forms an integral component in the evaluation of thyroid swellings. Thyroid Imaging Recording And Data System (TIRADS) is a classification system for thyroid nodules,which classify them into benign or malignant, based on ultrasound characteristics. Still histopathological examination is the goal standard for the classification of thyroid swellings. This study aims to assess the accuracy of TIRADS
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ABSTRACT

Background and Objectives

Swellings of thyroid are frequently encountered in surgical practice. Clinical evaluation helps in early diagnosis but it is difficult to distinguish early malignant lesions from the most prevalent benign goiters. Various diagnostic modalities are available to distinguish between benign from malignant thyroid nodules. Ultrasound forms an integral component in the evaluation of thyroid swellings. Thyroid Imaging Recording And Data System (TIRADS) is a classification system for thyroid nodules, which classify them into benign or malignant, based on ultrasound characteristics. Still histopathological examination is the goal standard for the classification of thyroid swellings. This study aims to assess the accuracy of TIRADS classification in the evaluation of thyroid swellings by comparing with cytological examination reports.

Methodology

A proforma was drafted for the study of all patients presenting with history of palpable thyroid swelling in our hospital. Clinical presentations, FNAC and Ultrasound findings of all cases were documented. Based on ultrasound findings, patients were grouped into different classes of TIRADS and findings compared with FNAC.

Results

100 cases who presented with thyroid swellings were studied and their TIRADS class was compared with the FNAC. Out of the 100 cases, 93 were females and 7 were males, being 13.3 : 1.TIRADS 4b showed maximum frequency with 40 patients. TIRADS 4a included 16 patients, TIRADS 4c included 15 patients, TIRADS 2 included 11 patients, TIRADS 5 included 10 patients, TIRADS 3 included 6 patients and TIRADS 1 included 2 patients. TIRADS 4b, 4c and 5 showed malignant cases. TIRADS 4b showed 7.5% malignant cases. TIRADS 4c showed 66.7% malignancy. TIRADS 5 showed 100% malignancy.

Interpretation and Conclusion

The majority of our patients were between third and fourth decade, of which females being predominant. The majority of cases were benign of which colloid goiter being the most dominant pathology (62 %). Among the malignancies, majority were papillary carcinoma (60 %). Ultrasound thyroid is cheap, easy and can be done on outpatient basis. Addition of TIRADS score to clinical suspicion is very much helpful in picking up high risk cases, especially in a country like India where the rural patient load is very high and follow up is not standardized. TIRADS 4b showed 7.5% malignant cases. TIRADS 4c showed 66.7% malignancy. TIRADS 5 showed 100% malignancy.

KEYWORDS: Fine needle aspiration cytology; Thyroid nodule; TIRADS.

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INTRODUCTION

Thyroid swelling is a common presentation in surgery department. Majority of these are benign diseases, of which goiter is the commonest and a few are malignant. The magnitude of problem in South East Asia is estimated to be around 172 million with goiters and Iodine deficiency is estimated to be around 600 million. It has been estimated that about 42 million people in India suffer from thyroid diseases**.** Thyroid swellings are common clinical findings and have a reported prevalence of 4% to 7% in the adult population. Discrete thyroid swellings are common and are present in 8.5% population in India. Thyroid swellings are four times more common in females. Thyroid swellings can be isolated or dominant. True incidence of thyroid nodularity is less apparent on clinical classification. When such glands are exposed at operation, clinically impalpable nodules may be detected. The usual presentation of thyroid disease is with swelling, pressure symptoms or signs of toxicity. Importance of solitary thyroid nodule is that the risk of neoplasia when compared to other thyroid nodules is high. Fifteen percent of STN are malignant. However, clinical presentation alone cannot differentiate benign from malignant. Complications of surgery are injury to RLN, hypoparathyroidism, life-long thyroid hormone replacement. The available tools to know the nature of a thyroid nodule are thyroid function tests, thyroid antibody titers, isotope scans, ultrasonography and fine needle aspiration cytology. Cytological and histopathological examination still

remains the gold standard in evaluation of thyroid nodules. Ultrasonography is an important component in the work up of thyroid nodules. Ultrasonography provides advantages including portability, cost effectiveness, lack of ionizing radiations and non invasiveness. Hence clinical suspicion when coupled with ultrasound features, to a great extent , can categorize the patients into high risk or low risk. In a developing country like India , where patient load is high and man power available in health care is out of proportionally low ,cost effectiveness is very important. Thus ultrasound renders an important role in evaluation of thyroid nodule. To standardise ultrasound findings TIRADS classification can be used. TIRADS scoring system classifies thyroid nodules into 6 classes, based on certain sonographic features and thus help differentiate benign from malignant. Nevertheless ultrasound has lot of limitations including the difference in resolution of the equipment, observer variations and overlapping of findings. TIRADS classification tries to minimize these shortcomings.

AIM OF THE STUDY

To assess the accuracy of TIRADS classification in the risk stratification of thyroid swellings.

OBJECTIVES

1. To determine the role of ultrasound in the diagnosis and management of thyroid disorders.
2. To evaluate the accuracy of TIRADS classification in diagnosis of thyroid disorders.
3. To distinguish between the malignant and benign solitary nodular lesions, thereby reducing the cost of unnecessary surgery for a benign lesion.
4. To confirm the clinically obvious malignancy of thyroid thereby determining the type of surgery.

REVIEW OF LITERATURE

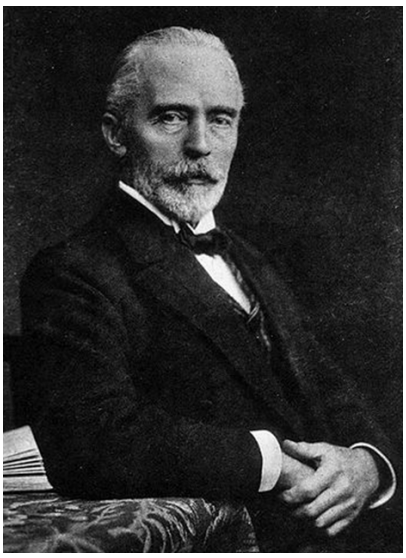
Historical aspects

Wharton in 1645 coined the term ‘thyroid’. Galen in 2 A.D, was aware of the existence of thyroid gland, but thought it was meant for lubrication of larynx. Sir Astley Cooper (1768-1841) suggested secretory function. Kendall (1965) first isolated Thyroxine-T4. Harrington and Banger (1927) first synthesized it. In 1953, Cross and Pitt-rivers and Roche, Liesitsky and Michel simultaneously discovered 3, 5, 3 Tri-iodothyronine. Radioactive iodine was introduced in 1934, was helpful in understanding thyroid physiology.

Early operations

The first credible account of thyroid surgery was given, by Roger Frugardi of Salerno in 1170. Pierre Joseph Desault (1744-1795) conducted the first partial thyroidectomy in Paris in 1791. By the 19th century, the advent of general anaesthesia (1840's), antisepsis (1860's) and haemostasis (1870's), helped surgeons to undertake more thyroid operations, with greatly reduced morbidity and mortality. Between 1850 and 1977, the world wide operative mortality reduced to around 20%. During this period, both Theodor Kocher (1841- 1917) and Theodor Billroth (1829-1894) performed thousands of thyroidectomies, and success rate increased. Kocher discovered that development of myxoedema could be prevented by subtotal thyroidectomy. Kocher was awarded the Nobel Prize in 1909 for his works on the physiology,pathology and surgery on thyroid glands. Theoder Kocher is regarded as father of thyroid surgery.

Fig. 1 .



EMIL THEODOR KOCHER (1841-1917)

Embryology

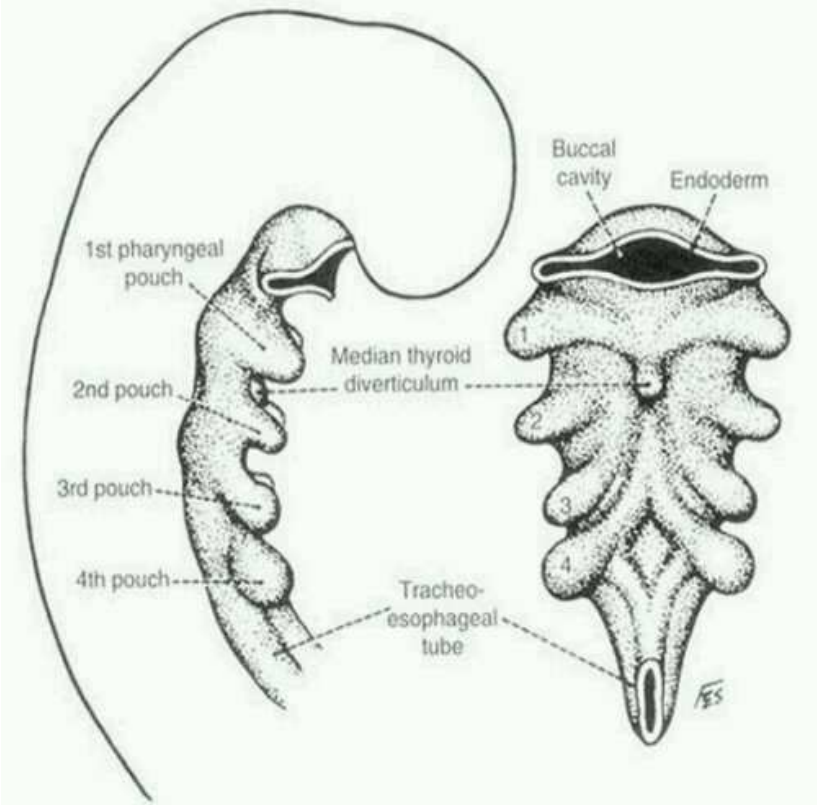


Fig. 2 . Thyroid embryology

At third week of gestation, thyroid arises as an outpouching from the primitive foregut . It originates from the base of tongue at the foramen caecum. The lateral anlages are neuroectodermal in origin (ultimobranchial bodies) and they develop into calcitonin producing parafollicular cells or C cells.

Surgical anatomy

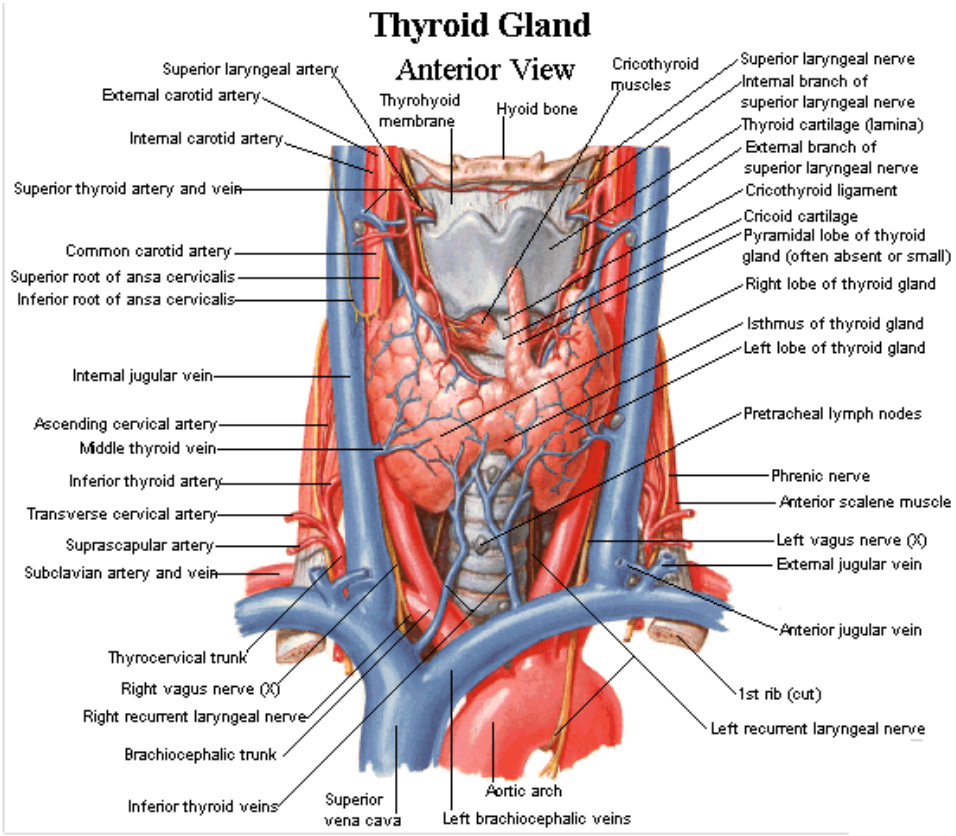


Figure 3. Thyroid gland, anterior view

The adult thyroid gland is brownish-red in colour and is situated in the lower neck anteriorly, from the level of the fifth cervical vertebra down to the first thoracic vertebra, overlying second to fourth tracheal rings.

Thyroid weighs about 20 gm in adults (it is slightly heavier in women). Thyroid glands are located adjacent to the thyroid cartilage, and the isthmus is located just below the cricoid cartilage. A pyramidal lobe is seen in about 50% of patients. Two pairs of parathyroid glands lie in close proximity to the thyroid gland.

Nerve supply of the thyroid

Main nerve supply of the thyroid gland is from the autonomic nervous system. Parasympathetic fibers are derived from the vagus nerves, and sympathetic fibers are distributed from the superior, middle, and inferior sympathetic ganglia .

Ligament and fascia

The thyroid gland is ensheathed by a division of the middle layer of deep cervical fascia, which attaches it firmly to the laryngeal skeleton.

Vascular supply

The arterial supply to the thyroid gland comes from the superior and inferior thyroid arteries and a small percentage from the thyroid ima. The superior thyroid artery is the first branch of the external carotid artery. The inferior thyroid artery is a branch of thyrocervical trunk, which again is a branch of the subclavian artery. The inferior thyroid artery is closely associated with the recurrent laryngeal nerve.

Venous Drainage

Venous drainage for the thyroid gland is provided by three pairs of veins. The superior thyroid vein runs along with the superior thyroid artery and drains into the internal jugular vein. The middle thyroid vein drains directly and laterally into the internal jugular vein. The inferior thyroid veins have different paths on either side.

Nerve supply

The left recurrent laryngeal nerve arises from the vagus nerve where it crosses the aortic arch and loops around ligamentum arteriosum and ascends in the neck in the tracheoesophaeal groove. The right recurrent laryngeal nerve arises from the vagus at the level of the right subclavian artery.

Lymphatics

Lymphatic drainage of thyroid gland is extensive and flows multidirectionally. Intraglandular lymphatic vessels connect both lobes of thyroid through isthmus and drain into perithyroid structures and lymph nodes. Regional lymph nodes include pretracheal, and paratracheal, periglandularnodes; which drain to the prelaryngeal (Delphian), nodes ; to retrophayngeal, esophageal, and superior mediastinal, upper,middle and lower jugular lymph nodes. There can also be “skip” metastasis to nodes in the ipsilateral neck.

Structure

The thyroid has an inner true capsule under the middle layer of deep cervical fascia, which is very thin and adheres closely to the gland. Extensions of this capsule form numerous septae within the substance of the gland, which divide the gland into lobes and lobules. The lobules are formed of follicles (200-900 microns), which forms the structural unit of the gland. The follicle is lined by a single layer of cells, which may vary from flattened to cuboidal cells depending on activity and enclosing a colloid filled cavity.

The colloid contains an iodinated glycoprotein – iodothyroglobulin which is a precursor of thyroid hormones. Epithelial cells are of 2 types - principal cells (follicular) and parafollicular cells (C, clear, light cells). Principal cells are responsible for formation of the colloid (iodothyroglobulin), whereas parafollicular cells produce calcitonin, a hormone central to calcium homeostasis. Parafollicular cells lie adjacent to the follicles within the basal lamina.

Cytology of normal thyroid gland

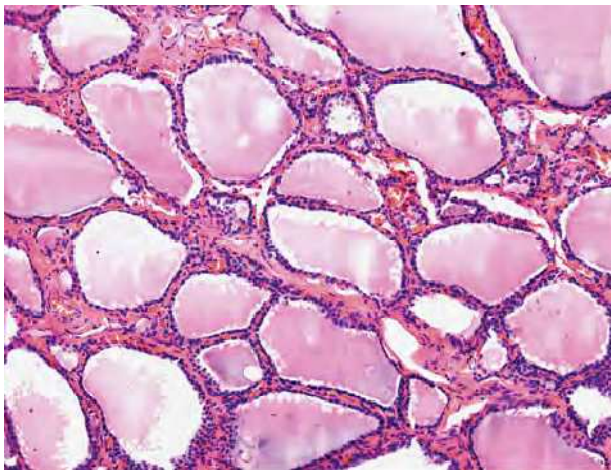


Fig. 4 :**Normal thyroid histology- Follicular cells surround colloid**

Physiology

The primary function of thyroid is the production of sufficient thyroid hormone for regulation of cellular metabolism throughout the body. The thyroid hormones triiodothyronine (T_3) and L-thyroxine (T_4) {extracted by Kendall EC in 1953} are bound to thyroglobulin in the colloid.

Iodine metabolism

Iodine is taken in the form of Iodides. Sea fish, egg and milk are good dietary source of iodine. Dietary iodide gets absorbed from upper GIT and is carried as inorganic iodide in the plasma. Thyroid and kidney are the principal organs involved in iodine metabolism.

An adult man requires 0.15 mg of iodine per day and an adult female requires 0.10 mg. Children, pregnant and lactating women require more iodine. The daily requirement is met by diet and drinking water, except in hilly areas where food and water may be deficient in iodine.

Synthesis, secretion and transport of thyroid hormones

Four steps are involved in the synthesis of thyroid hormones :

1)Iodine trapping

Iodine is trapped in the inorganic form by the thyroid.

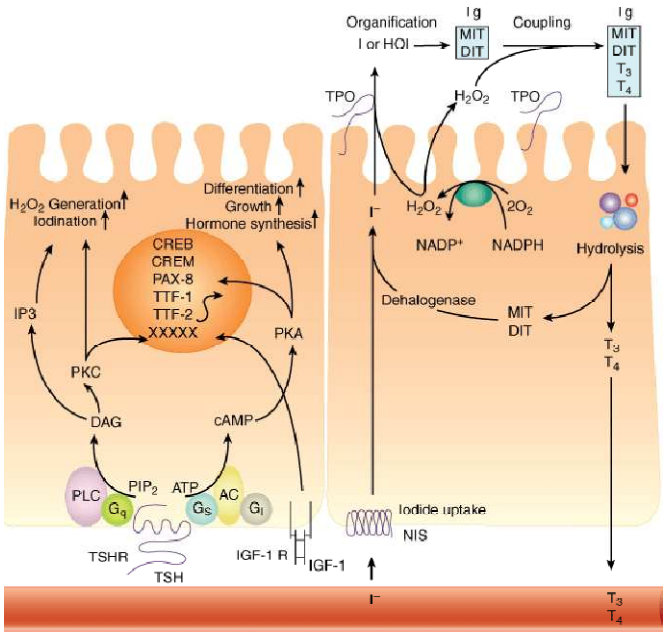


Fig. 5 : Synthesis, secretion and transport of thyroid hormones

2)Iodine binding

The inorganic iodide is oxidized to iodine in the thyroid follicular cells by an enzyme peroxidase.

3)Coupling

Coupling of two molecules of DIT produce Thyroxine (T4) . Triiodothyronine (T3) is formed by coupling of one molecule each of MIT and DIT. They are oxidation reactions and need peroxidase enzyme.

4)Hormonal release

At first Thyroglobulin is taken up by the follicular cells. TSH a protease acts on thyroglobulin to form T4, T3, MIT and DIT. T4 and T3 directly enters the circulation from the follicular cells. On entering the circulation, thyroid hormones are largely bound to specific transporter proteins called thyroxine-binding globulin (TBG), thyroxine binding albumin and thyroxine binding prealbumin (TBPA).

Differences between T3 and T4

T3 has quicker onset of action and is effective in small doses. It is three to four times more active than T_4. The onset of action of T3 is within 6-8 hours while that of T4 lasts for 4-14 days. The half life of T_3 is 1 day while that of T4 is 7 days. T3 is physiologically more important, reverse T3 is an inactive form of T3.

Regulation of thyroid function

Regulation of thyroid function is by two mechanisms - suprathyroid and intrathyroid regulations. The suprathyroid regulation is mediated by thyroid stimulating hormone (TSH). The intrathyroidal regulation is an autoregulatory mechanism. The thyroid reduces the iodine trapping when there is sudden increase in the supply of iodide, without the negative feedback mechanism.

Etiology of benign disorder

Over stimulation of thyroid gland by TSH produces simple goiter, overstimulation may be due to either a microadenoma in the anterior pituitary which produces inappropriate secretion of TSH (which is rare) or in response to a low level of circulating thyroid hormones.Defective synthesis of thyroid hormones also produces some sporadic goiters.

(a) Iodine deficiency

Daily iodine requirement is about 0.1 to 0.15 mg.In places where simple goiter is endemic, there is very low iodine content in food and water. However in situations where iodine excess occurs, disease processes such as Hashimoto’s thyroiditis and Grave’s disease can occur.

(b) Chemical goitrogens

Iodides in large quantities can inhibit organic binding of iodine and produce goiter (Wolf – Chaikoff effect).

(d)Drugs as goitrogens

Brassica family vegetables (cabbage, rape and kale) which contain thiocynate and drugs like PAS (para-amino salicylic acid) and anti thyroid drugs are goitrogens.

Thiocynates and perchlorates inhibit iodine trapping, while carbimazole and thiouracil compounds inhibit oxidation of iodide and interfere with binding of tyrosine.Massive steroid therapy may result in functional hypothyroidism.

(d) Genetics and immunology

Grave's disease is associated with Human Leucocyte Antigen (HLA) haplotypes – HLA-B^8, HLA- DR^3 and HLA – DQAI.The hypertrophy and hyperplasia is caused by abnormal thyroid stimulating antibodies (TSH-RAb) that bind to TSH receptor and produce a disproportionate and prolonged effect.

Etiology of malignancy

(a)Radiation

Papillary carcinoma is associated with irradiation of thyroid gland below 5 yr of age. Mean age of presentation is 30 to 40 yrs. Patients who have received external radiation for soft tissue malignancy like Hogdkin's lymphoma are at increased risk of developing malignancy.

(b)Raised TSH levels

Raised TSH stimulation increase the incidence of follicular carcinoma.

(c)Genetic predisposition

Sporadic, familial medullary and follicular carcinomas are associated with RET oncogen mutation. RET/PTCB is associated with short latency aggressive papillary carcinoma. P^{53} mutation is associated with undifferentiated thyroid cancer and thyroid cancer cell lines. PAX ^{8} gene is found to have an important role in follicular neoplasms, including follicular carcinomas.

PATHOLOGY

A normal thyroid gland is not palpable. 'Goiter' (*latin - gutter= throat*) is used to describe the generalised enlargement of thyroid gland. A discrete swelling (nodule) with no other palpable abnormality in the thyroid gland is termed as solitary or isolated swelling. Discrete swelling with abnormality elsewhere in the gland is termed as dominant. Thyroid enlargement can be categorized as follows:

CLASSIFICATION OF THYROID SWELLINGS

1. Simple goiter (Euthyroid)

    Diffuse hyperplastic

        -Pubertal

        -Physiological

        -Pregnancy

    Multinodular goiter

2. Toxic

    Toxic adenoma

    Multinodular

    Diffuse- Graves disease

3. Neoplastic

    Benign

        -Follicular adenoma

        -Papillary adenoma

        -Atypical adenoma

        -Hyalinisingtrabeculated adenoma

    Malignant

      -Papillary carcinoma

        -Follicular carcinoma

            -Medullary carcinoma

            -Anaplastic carcinoma

            -Poorly differentiated carcinoma

4. Inflammatory

    Autoimmune

            -Chronic lymphocytic thyroiditis

            -Hashimoto’s thyroiditis

Granulomatous

-De Quervain's thyroiditis

Fibrosing

-Reidel's thyroiditis

Infective

-Acute – Bacterial thyroiditis

Viral thyroiditis

Subacute thyroiditis

-Chronic – Tubercular, Syphilitic, etc.

-Others

-Amyloid

DIAGNOSIS

The diagnosis of thyroid diseases is based on the evaluation of thyroid functions and based on the nature of the lesion, benign or malignant.

INVESTIGATIONS

ESSENTIAL

A) Serum

TSH (T_4 and T_3, if abnormal)

TAA (Thyroid auto antibodies)

B) FNAC

Fine needle aspiration cytology of all discrete palpable swellings.

C) Ultrasound Neck

OPTIONAL

A) Calcium and albumin

B) Chest radiography and thoracic inlet to rule out deviation of trachea and retrosternal extension

C) CT / MRI are rarely indicated

D) Isotope scan if discrete swelling and toxicity co-exist.

TESTS OF THYROID

Serum TSH

Serum TSH levels (0.5 to 5 microU/ml-normal) can be measured to even very low concentrations by radiochemiluminometric assay.

The ultrasensitive assays can detect TSH levels as low as 0.01 microU/ml. There is an inverse relationship between free T_4 level and logarithm of TSH level.Hence small changes of free T_4 can lead to large changes in TSH levels. So, the ultrasensitive TSH levels have become more sensitive and specific test for the diagnosis of hypo or hyperthyroidism, and for optimizing the T_4 suppressive and replacement therapy.

Triiodothyronine (T_3) and Thyroxine (T_4)

The total T_4(normal- 55 to 150 nmol/L) and T_3 (normal-1.5 to 3.5 nmol/L) levels can be measured by radioimmunoassay. Both the free levels and bound levels of the hormones can be measured. Only a small level of

both T_3 and T_4(0.03% of T_4 and 0.3% of T_3) are free and physiologically active. T_3 toxicity (normal T4) is a separate entity and can be diagnosed by measuring the serum T_3(suppressed TSH with a normal T_4 level is suggestive).

ULTRASOUND

It is an excellent noninvasive imaging modality. It is helpful to distinguish between sloid and cystic lesions in thyroid nodules. It also provides information about size and multicentricity. It is also used to assess lymph node status and for guided FNAC, especially B-mode that can be used preoperatively and intraopertively.

CT / MRI SCAN

It gives excellent view of the thyroid gland and the adjacent lymph nodes. It is particularly useful in evaluating large, fixed and substernal goiters and their relationship with trachea and vascular structures. Non-contrast CT should be done in patients with possibility of further radioactive iodine therapy.

FNAC and HPE of THYROID LESIONS

1. Low cellular smears are benign and high cellular smears are suspicious.
2. Degenerative changes and old haemorrhages are seen as histiocytes, which are seen as large cells with peripherally pushed pyknotic nuclei and cloudy cytoplasm, with many vacuoles and granules of degraded or digested material.
3. Hurtle cells look longer than follicular cells, with well defined cellular borders, granular cytoplasm and moderate to large nuclei.
4. Inflammations and malignancy can be ruled out.

THYROID ANTIBODIES

These are anti-thyroglobulin (anti-Tg), anti-thyroid peroxidase (anti-TPO) and thyroid stimulating immunoglobulins (TSI). They are used to evaluate thyroid dysfunction and swellings. Auto immune thyroiditis may be associated with simple goiter or failure or thyrotoxicity. Levels above 25 units per ml of TPO antibody and titres above 1:100 for antithyroglobulinare significant, but a large proportion of patients with histological evidence of lymphocytic (auto-immune) thyroiditis may be seronegative.

SERUM THYROGLOBULIN

Thyroglobulin is normally not found in circulation in large amounts, but its levels increases drastically in destructive processes of thyroid like thyroiditis or in overactive states like Graves disease and toxic multinodular goitre. The most important use of thyroglobulin is in monitoring the patients with differentiated thyroid cancer, following total thyroidectomy or radioactive iodine ablation for recurrence.

ISOTOPE SCANNING

Iodine-123(^{123}I) and iodine-131 (^{131}I) are used to scan thyroid. ^{123}I emits low dose iodine which can be used to image lingual thyroid or goitre. ^{131}I produces higher dose of radiation exposure and its used to treat patients with differentiated thyroid cancer for metastatic disease.

Routine use of isotope scan is not necessary and it cannot be used for distinguishing benign from malignant lesions, because majority of cold swellings are benign (80%) and small number(5%) of functioning or warm swellings are malignant. It is mainly used in the toxic patient with nodularity. Localization of overactivity in the gland is used to differentiate a toxic nodule from a toxic MNG with several areas of increased activity in the gland.

Technetium – 99m (^{99m}Tc) pertechnetate is also used for thyroid evaluation and it has a shorter half- life and minimum radiation exposure. Its particularly sensitive to nodal metastasis.

A.Suppurative thyroiditis

Acute suppurative thyroiditis from bacterial infections is rare. The aspirates are highly cellular consisting of neutrophils, macrophages and cellular debris.

B. Sub acute (de Quervain's thyroiditis)

Aspirates demonstrate presence of lymphocytes, plasma cells, epithelioid histiocytes and multi nucleated giant cells containing 30 – 300 nuclei.

C. Hashimoto's thyroiditis

Lymphocytic thyroiditis (Hashimoto's thyroiditis) is an auto immune disease that can present as diffuse enlargement of thyroid or as solitary or multiple nodules. Fine needle aspiration usually consist of numerous lymphocytes and plasma cells with follicular cells showing oncocytic features (Hurtle cells). Hurtle cells contain dense abundant granular cytoplasm and may possess hyperchromatic highly atypical nuclei. The recognition of Hashimoto's thyroiditis is difficult for the cytopathologist, especially when only inflammatory or and epithelial components are present. This can produce false positive diagnosis of lymphoma or carcinoma, especially Hurtle cell tumour.

D. Riedel's struma

The aspirate contains mature lymphocytes and some fibroblasts.

BENIGN NON NEOPLASTIC LESIONS

A. Non toxicGoitres

1) SIMPLE GOITRE (COLLOID GOITRE)

The smear is scanty or moderately cellular with large amounts of colloid and epithelial cells, the cells are arranged in discrete fashion, in clusters and in sheets.

2) MULTINODULAR GOITRE

Smear shows plenty of colloid in the background of which, epithelial cells are found in microfollicle formation and cyst macrophages together gives a chess board pattern. Hemosiderin laiden macrophages and histiocytes are usually conspicuous. Microscopically, there is partially or completely encapsulated nodules, which exhibit focal cystic degeneration and necrosis. There is colloid distended follicles of various sizes and shapes separated by fibrous bands.

B.Toxicgoitre

Smears are bloody with flare cells,naked nuclei and follicular cells with abundant finely granular cytoplasm and peripheral vacuoles.

Follicles are of diversified size and shape with variable amounts of colloid.

Epithelium is highly columnar, sometimes multilayered, and may protrude into the lumen, suggesting a papillary neoplasm.

NEOPLASMS

A. Follicular neoplasm

Cytologically it is quite difficult to differentiate between follicular adenoma and follicular carcinoma. Unless vascular and capsular invasion is evident, it is difficult even in histology. Hence both follicular adenoma and carcinoma are both excised. The following are certain distinguishing features:

a) Follicular adenoma

The aspirate contains scanty colloid. The cells have microfollicular structure with small, round, and uniform nuclei.

(b)Follicular carcinoma

The aspirate is bloody with isolated follicles or follicles which are laid in small sheets. The cells shows atypia to frankly malignant transformation. The nuclei are large, oval and eccentric, better appreciated by plantimeteric study. Benign lesions demonstrate honey-comb, sheets of follicular cells. Over lapped, crowded cells indicate well differentiated follicular carcinoma.

Histologically, it may be apparently encapsulated or diffusely infiltrating, well or poorly differentiated. It is differentiated morphologically from adenoma by capsular and vascular invasion.

B. Papillary carcinoma

Papillary carcinomas may present as solitary or multifocal lesions within the thyroid. They can be well circumscribed or encapsulated; but sometimes it may infiltrate the adjacent parenchyma showing ill-defined margins. Macroscopically, they may be granular or may show grossly visible papillary foci.

The diagnosis of papillary carcinoma is based on individual cellular morphology. The nuclei is characteristically empty and pale staining, giving rise to the so called "ground-glass" or "Orphan Annie eye" nuclei. There may be cytoplasmic invaginations giving rise to the appearance of intranuclear inclusions (hence the term pseudo-inclusions) . Sloughed papillary projections produce concentric calcified structures termed ‘psammoma bodies’ within the papillae.

C. Medullary carcinoma

Microscopically, smears of medullary carcinomas are composed of polygonal to spindle-shaped cells. They may organize form nests, trabeculae, or even follicles. Acellular amyloid deposits**,** derived from altered calcitonin molecules, are present in the adjacent stroma in most cases and are a characteristic feature of these tumors. Calcitonin is demonstrable both within the cytoplasm and in the stroma by immunohistochemical methods. Familial medullary carcinomas shows multicentric C-cell hyperplasia in the

surrounding thyroid parenchyma, a feature which is usually absent in sporadic lesions.

D. Anaplastic carcinoma

Microscopically, anaplastic neoplasms are composed of anaplastic cells, which may show several histologic patterns, including

(1) Large, pleomorphic giant cells

(2) Spindle cellsshowing sarcomatous appearance

(3) Mixed spindle and giant-cell lesions

(4) Small cells

Foci of papillary or follicular differentiation may be present in some, suggesting origin from a better differentiated carcinoma.

E.Hurtle cell neoplasms

Hurtle cell adenoma

It is a variant of follicular neoplasm, smear demonstrates large follicular cell devoid of follicular structures. Microscopically it contains follicles with regular epithelium, colloid may be abundant or absent.

It is difficult to differentiate between benign and malignant Hurtle cell tumours. The cells are oval to polyhedral with abundant granular cytoplasm and a prominent large eccentric nucleus.

The cells are isolated or arranged in loose groups, marked nuclear pleomorphism indicates malignancy.

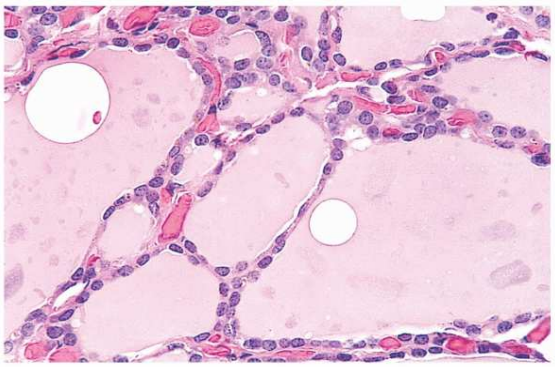


Fig. 6 .Normal thyroid follicle lined by thin layer of cuboidal follicular epithelial cells

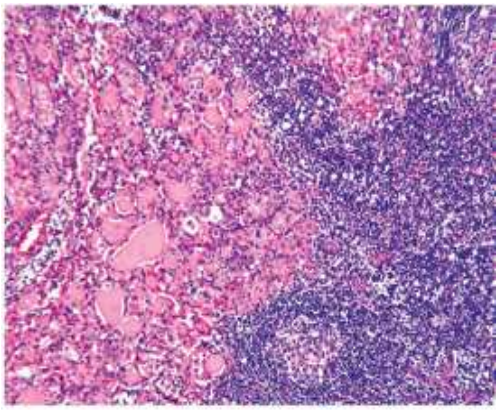


Fig. 7 .**Hashimotos thyroiditis**

Fig. 8 .**Gross specimen of follicular adenoma**.

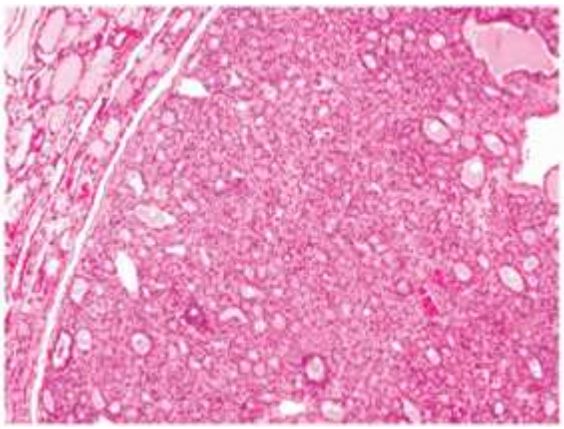


Fig. 9.**Follicular adenoma with no capsular or vascular invasion.**

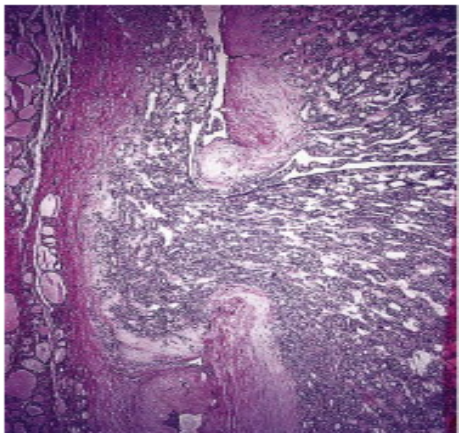


Fig. 10.**Capsular invasion of follicular carcinoma**.

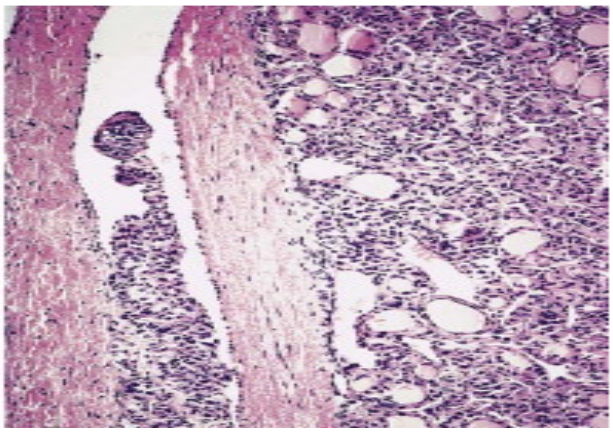


Fig. 11.**Vascular invasion of follicular carcinoma**.

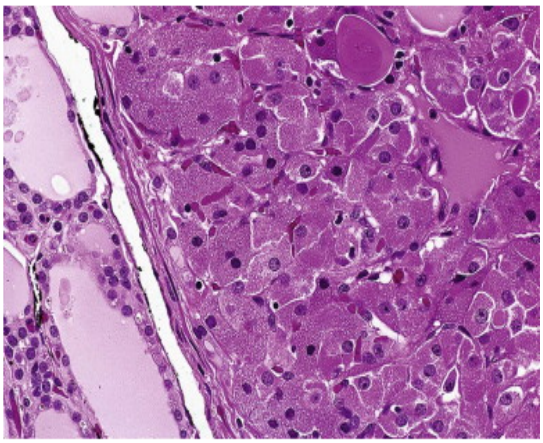


Fig. 12.**Hurtle cell adenoma**

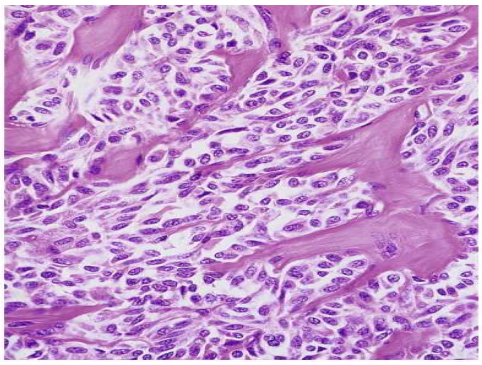


Fig.13. **Medullary carcinoma with amyloid stroma.**

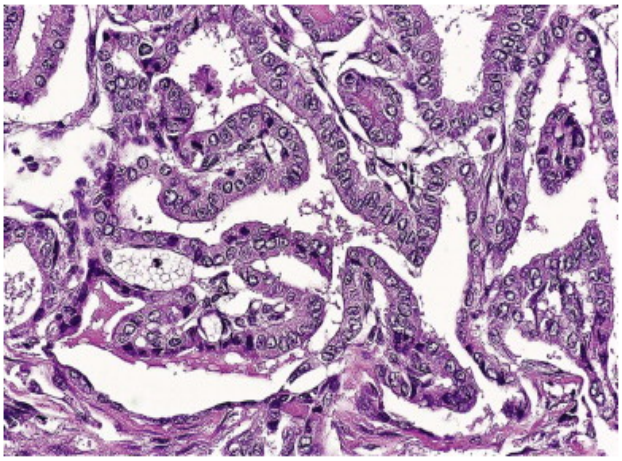


Fig. 14.**Papillary carcinoma**

FINE NEEDLE ASPIRATION CYTOLOGY

Aspiration biopsy cytology is a branch of diagnostic cytology that analyze cells harvested from the organs, tumours and non neoplastic abnormal tissues to arrive at a diagnosis(Joseph and Link 1983).

The technique of fine needle aspiration (FNA) was developed in New York city at Memorial Hospital in the 1920s. But it was popularized in the Europe years later, particularly in Scandinavian countries, where its safety and accuracy were fully established. Later it was brought back to United States where it was widely used for lesions of thyroid,breast , salivary glands, and lungs. It was carried out with a fine needle and sometimes under image guidance. The procedure was found to be with no doubt inexpensive, safe, quick and when performed in experience hands – quite accurate.

ADVANTAGES OF FNAC

1. The technique is safe, simple and acceptable to most patients.
2. It can be done without any preparation or anaesthesia.
3. It takes less than 5 minutes to perform and its interpretation is also rapid,can be reported within an hour.
4. Representative sample is taken because the needle enters various areas of the nodule.
5. If an inadequate sample was obtained in the first instance the technique can be repeated without much patient discomfort.

6. It is an accurate and cost effective investigation and does not require hospital admission and can be done in an out-patient basis.
7. It is less traumatic and is of less complications.
8. From this technique definite morphological diagnosis can be made .
9. Cysts can be aspirated completely and thus it can be therapeutic too in such instances.

DISADVANTAGES OF FNAC

1. Minimal material is available for examination,so architecture and cell relationship cannot be made out.
2. Due to cystic lesions and cystic areas in thyroid, inadequate material may be aspirated .
3. The needle may miss important areas in the nodule despite a good attempt.
4. Distinction between follicular adenoma and follicular carcinoma is difficult as it needs capsular and vascular invasion to differentiate between the two.
5. Good cytopathologist is essential to interpret the results.

ACCURACY OF FNAC

(According to the study of Orrel SR et al)

Colloid goiter (simple nodular) – 96%

Hashimoto's thyroiditis – 90 to 95%

Papillary carcinoma of thyroid – 60 to 90%

Follicular carcinoma of thyroid – 70%

Grave's / Plummer's disease – variable (needs clinical and biochemical correlation).

COMPLIATIONS OF FNAC

Even though FNAC is considered a simple and safe procedure it may be associated with some complications which are encountered rarely:

1. Local discomfort.
2. Minor hematoma.

PITFALLS OF FNAC

Inadequate sampling : This could be because of poor cell in aspirate (as in cases of cyst or Hashimoto's thyroiditis or Riedel's thyroiditis) or haemorrhagic (as in adenoma or hyperplastic nodule). So second or a third attempt becomes mandatory.The percentage of unsatisfactory smears from various studies is found to be 0 to 20 %.

1. Geographical misses
2. Interpretational inaccuracies: Interpretation depends on the experience of the cytopathologist.

ULTRASONOGRAPHY

Ultrasound was first used for medical purposes by Dr George Ludwig in the late 1940s at the Naval Medical Research Institute, Bethesda, Maryland, . Physicist John wild (1914–2009) first used ultrasound to assess the thickness of bowel tissue (1949); he is known as the "father of medical ultrasound". Ultrasound is sound waves with frequencies higher than the audible frequency range. Ultrasound images are known as sonograms. Pulses of ultrasound are send into tissue using a probe. The sound echoes back off the tissue,with different tissues reflecting different degrees of sound. These echoes are recorded and displayed as an image .

Different types of images can be formed using ultrasound. B-mode image,which is the commonly used mode ,displays the acoustic impedance of a two-dimensional cross-section of tissue. Other types of image are used to demonstrate blood flow, motion of tissue ,the location of blood, the stiffness of tissue, or the anatomy of a region.

The frequency commonly used for medical imaging is in the range of 1 to 18 MHz. A sound wave is produced by a piezoelectric transducer.the sound waves reflected from the target tissue is received by the transducer.The

transducer converts the vibrations into electrical energy that travel to the ultrasonic machine where they are processed and transformed into a digital image. Whenever a sound wave encounters a material with a different density (acoustical impedance), only part of the sound wave is reflected back . The time taken for the echo to travel back to the probe is measured to calculate the depth of the tissue. If there is gas or solid structures, the density difference is so great that most of the acoustic energy is reflected and Hence it becomes impossible to see deeper.

Different modes available in ultrasound are:

A-mode: (amplitude mode) is the simplest type of ultrasound. It is used for depth assessment.

B-mode or 2D mode: In B-mode (brightness mode) ultrasound, a linear array of transducers simultaneously scans a plane through the body that can be viewed as a two-dimensional image on screen.

C-mode - A C-mode image is formed in a plane normal to a B-mode Image, but faster.

M-mode: (motion mode) This is used to determine the velocity of specific organ structures.

Doppler mode: This mode makes use of the Doppler effect in measuring and visualizing blood flow.

Colour doppler

Continuous doppler

Pulse wave doppler

Duplex

Pulse inversion mode

Harmonic mode

Advantages

1. It is useful for delineating the interfaces between solid and fluid-filled spaces.
2. It renders dynamic imaging. Live images also allow for ultrasound-guided biopsies or injections.
3. It shows the structure of organs.
4. It has no long-term side effects and does not cause any discomfort to the patient.
5. It is easily available and cheap.
6. Small, easily carried scanners are available so that bed side examinations can be done.
7. Relatively inexpensive compared to other modes of investigation, such as CT, MRI.
8. Spatial resolution can be assessed in a better way in high frequency
9. ultrasound transducers than in most other imaging modalities.
10. It can be used to direct interventional procedures like FNAC or aspiration in doubtful cases.

Disadvantages

1. Ultrasound cannot be used to visualise deep to bone.
2. If there is interveining air, deeper structures cannot be assessed.
3. The depth penetration of ultrasound depends on the frequency of imaging. So there may be difficulties imaging structures deep in the body, especially in obese patients.
4. Body habitus has a large influence on image quality.
5. The modality is operator-dependent. .
6. Once an image has been acquired there is no exact way to tell which part of the body was imaged.

Fig.15. ultrasound machine

TIRADS CLASSIFICATION

Thyroid Imaging and Reporting System (TIRADS) was proposed similar to BIRADS classification. It was proposed by Howarth. The classification is used to differentiate thyroid swellings into benign or malignant without invasive procedures, based on ultrasound evaluation of thyroid using suspicious Sonographic features.

CLASSIFICATION

TIRADS 1 - Normal thyroid gland

TIRADS 2 - Benign gland

TIRADS 3 - Probably benign

TIRADS 4 - Suspicious lesion

TIRADS 5 - probably malignant

TIRADS 6 - proven malignant

SUSPICIOUS SONOLOGICAL FACTORS

1. Solid components
2. Hypoechogenicity
3. Microcalcification
4. Taller than wider
5. Irregular margins

TIRADS 1

Normal thyroid gland with no features of nodularity or enlargement of thyroid.

TIRADS 2

Thyroid nodule without suspicious sonographic features but,iso / hyperoechoic, vascular,expansile and capsulated.

TIRADS 3

Thyroid nodule without suspicious sonographic features but heteroechoic, and partially formed capsule and peripheral vascularization.

TIRADS 4

TIRADS 4a - one of the suspicious sonographic features.

TIRADS 4b - two suspicious sonographic features.

TIRADS 4c - three / four suspicious sonographic features.

TIRADS 5

All of the suspicious sonographic features.

TIRADS 6

Biopsy proven malignancy.

Fig.16 : solid components

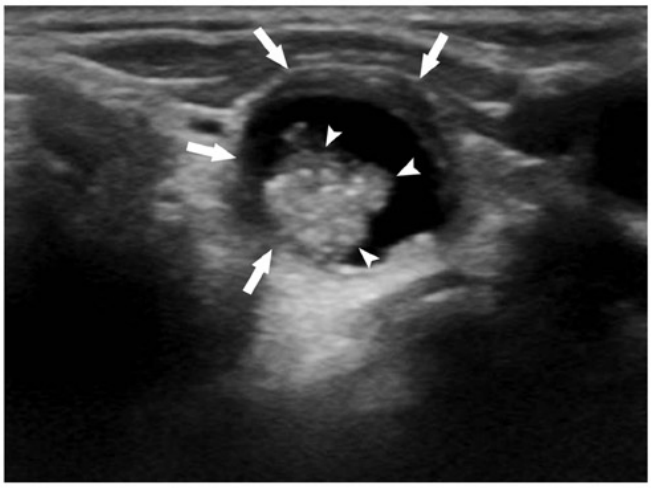


Fig.17 :Hypoechogenicity

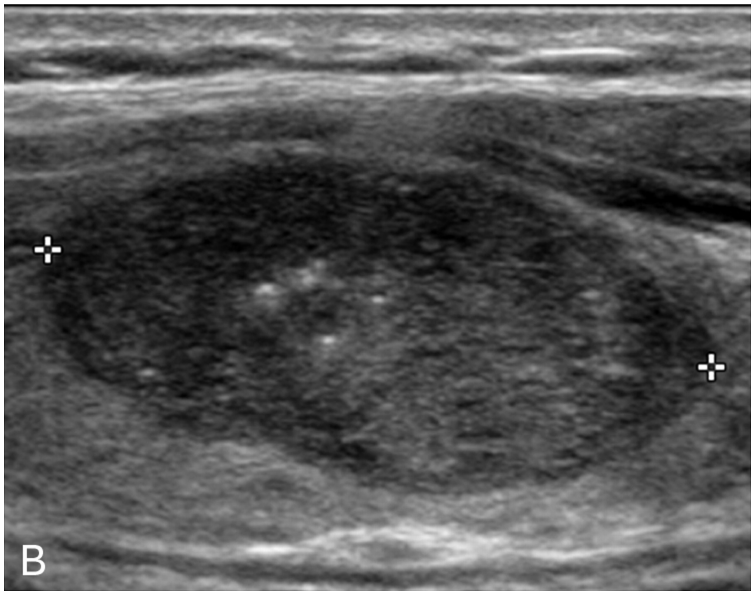
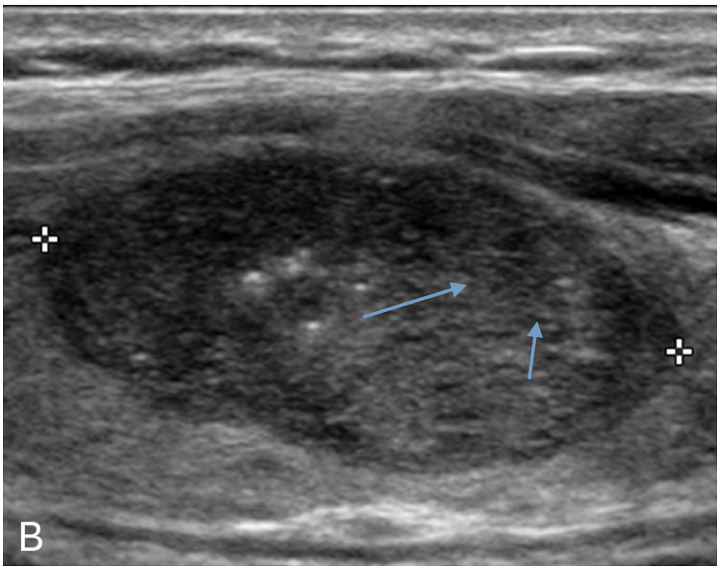
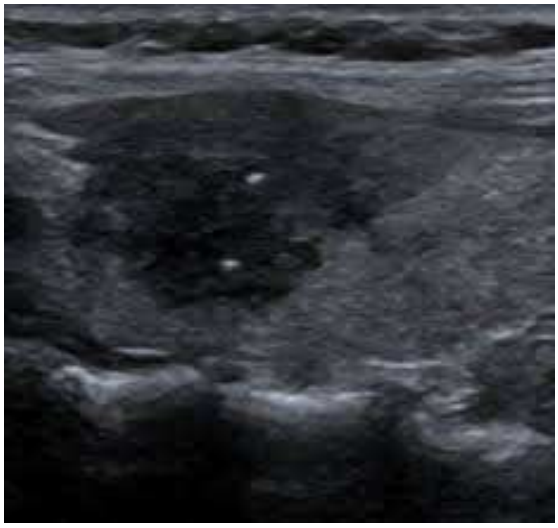


Fig.18 :Microcalcification



.Fig.19 : Taller than wide

Fig.20 : Irregular margins



METHODOLOGY

The study includes those patients admitted in the surgical wards of Tirunelveli Medical College Hospital from January 2014 to June 2015 for treatment of thyroid diseases.

Study design **:** A prospective study.

Place **:** Tirunelveli Medical College Hospital

Study period **:** From January 2014 to June 2015.

Source of data **:** Patients with thyroid swelling having admitted for thyroid surgery in the wards of Department of Surgery, Tirunelveli Medical College Hospital during the study period.

Sample size and method:

A total of 100 patients with thyroid swelling were studied.

SELECTION CRITERIA

INCLUSION CRITERIAS

The study includes those patients-

1. Getting admitted in the surgical wards for the treatment of various thyroid swellings.
2. Who are willing to co-operate for the study.

EXCLUSION CRITERIAS

The study excludes those patients

1. children below 12 years.
2. Not willing for FNAC.
3. Lost for follow up.

PROCEDURE

Patients with goiter were evaluated clinically. Relevant aspects of patient's history including age, sex, rapidity of growth, recent onset of hoarseness, dysphagia, dyspnoea, symptoms of hypo or hyperthyroidism, history of head and neck irradiation, family history of endocrine diseases were included.

Physical examination to determine whether the gland was diffusely enlarged, solitary, nodular or multinodular with symmetric or asymmetric enlargement was done. In nodular swelling, the size, shape, consistency, location and mobility was assessed. The patient was also examined for the presence of cervical lymphadenopathy.

A thyroid function test and an ultrasound were performed using a 7.5 MHZ high frequency linear array transducer. FNAC was carried out in the Department of Pathology, Tirunelveli Medical College Hospital. The ultrasound findings were classified into various classes of TIRADS and the same compared with FNAC diagnosis.

RESULTS

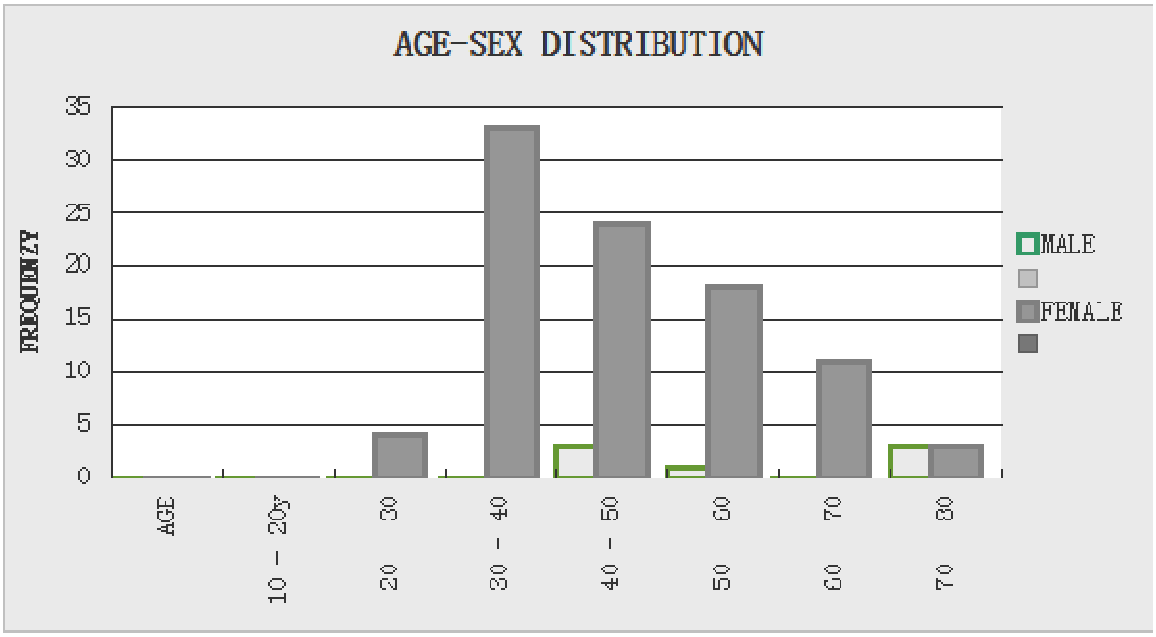
The **results** of the **100 patients** studied with their **FNAC and TIRADS classification** are as follows:

Age and Sex distribution

Table : 1

	MALE	FEMALE	TOTAL
AGE			
10 - 20y			
20 - 30		**4**	**4**
30 - 40		**33**	**33**
40 - 50	**3**	**24**	**27**
50 - 60	**1**	**18**	**19**
60 - 70		**11**	**11**
70 - 80	**3**	**3**	**6**
TOTAL	**7**	**93**	**100**

Fig.21. Bar diagram of Age- Sex distribution



Sex Distribution

Table 2.Sex distribution in thyroid swellings

	MALE	FEMALE	TOTAL
DISTRIBUTION	7	93	100

Fig.22. Bar diagram showing Sex distribution

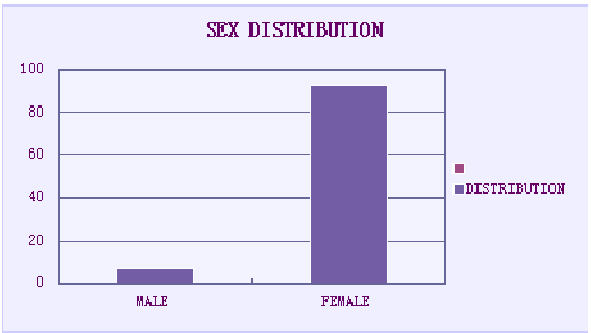
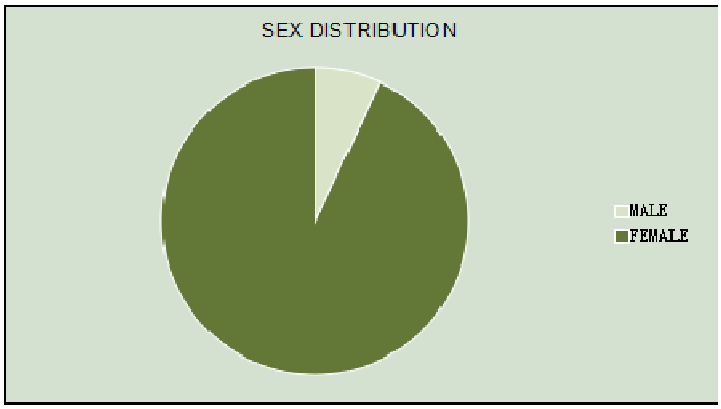


Fig.23. Pie chart showing sex distribution



Majority of the patients were in the fouth and fifth decade of life with a female predominance in all age groups. The female to male ratio in our study was found to be 13.2 :1. But above 70 years we had equal number of male and female patients.

BIOCHEMICAL STATUS

Table 3.Distribution of biochemical status

	EUTHYROID	HYPOTHYROID	HYPERTHYROID	S/C HYPOTHYROIDISM	S/C HYPERTHYROIDISM	TOTAL
FREQUENZY	86	3	7	3	1	100

Fig.24. Bar diagram showing biochemical status

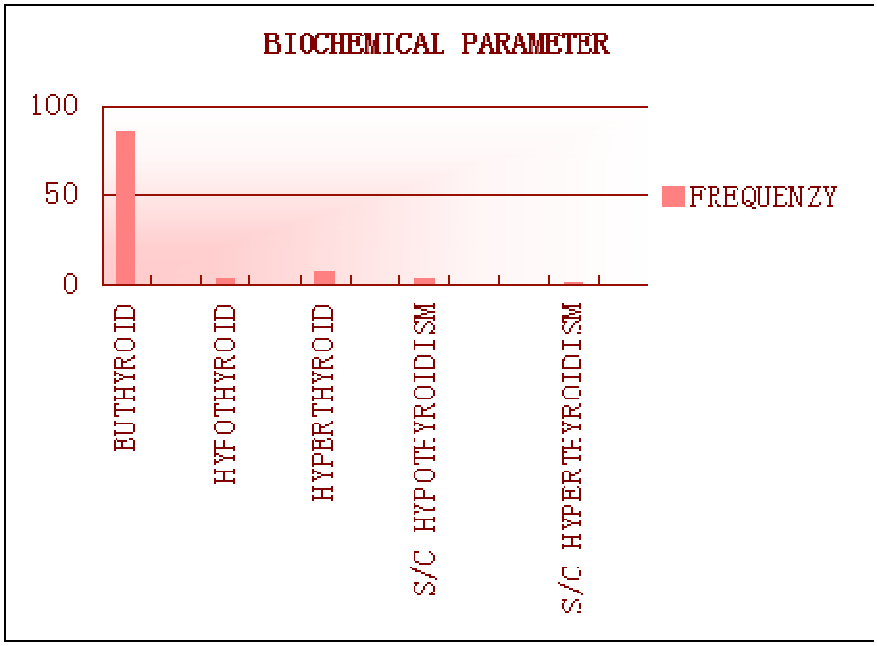
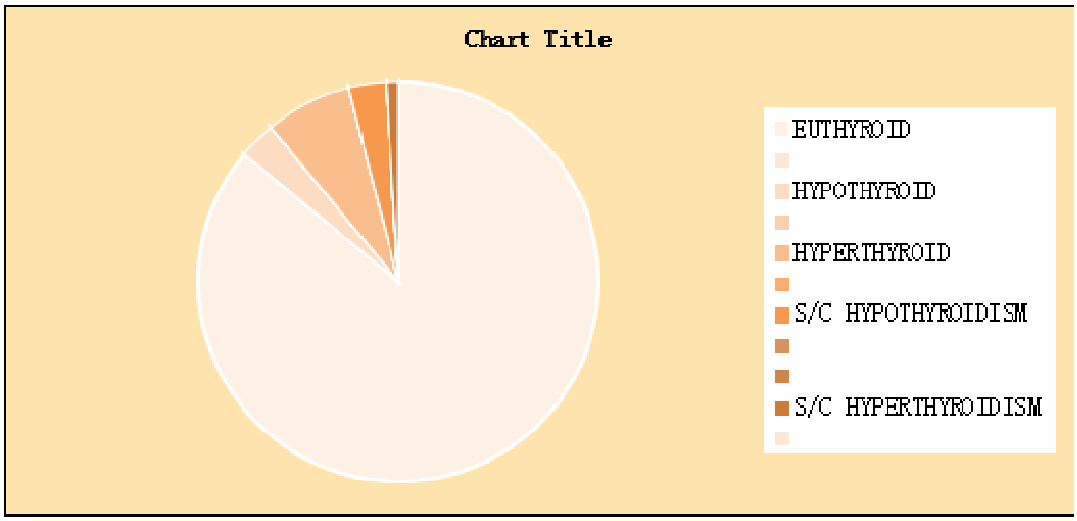


Fig.25. Pie chart showing biochemical status



Of the 100 patients studied, 86 of them were euthyroid, 3 hypothyroid, 7 hyperthyroid, 3 subclinical hypothyroidism and 1 subclinical hyperthyroidism,

Differential diagnosis of thyroid swellings

Table 4.Distribution of differential diagnosis of thyroid swellings

	COLLOID GOITRE	HASHIMOTOS	ANAPLASTIC CA	PAPILLRY CA	ADENOMA	MALIGNANCY	NORMAL	LYMPHOCITIC	FOLLICULR	HURTHLE CELL	TOTAL
FREQUENZY	62	11	1	12	2	3	2	3	3	1	100

Fig.26. Bar diagram showing differential diagnosis of thyroid swellings

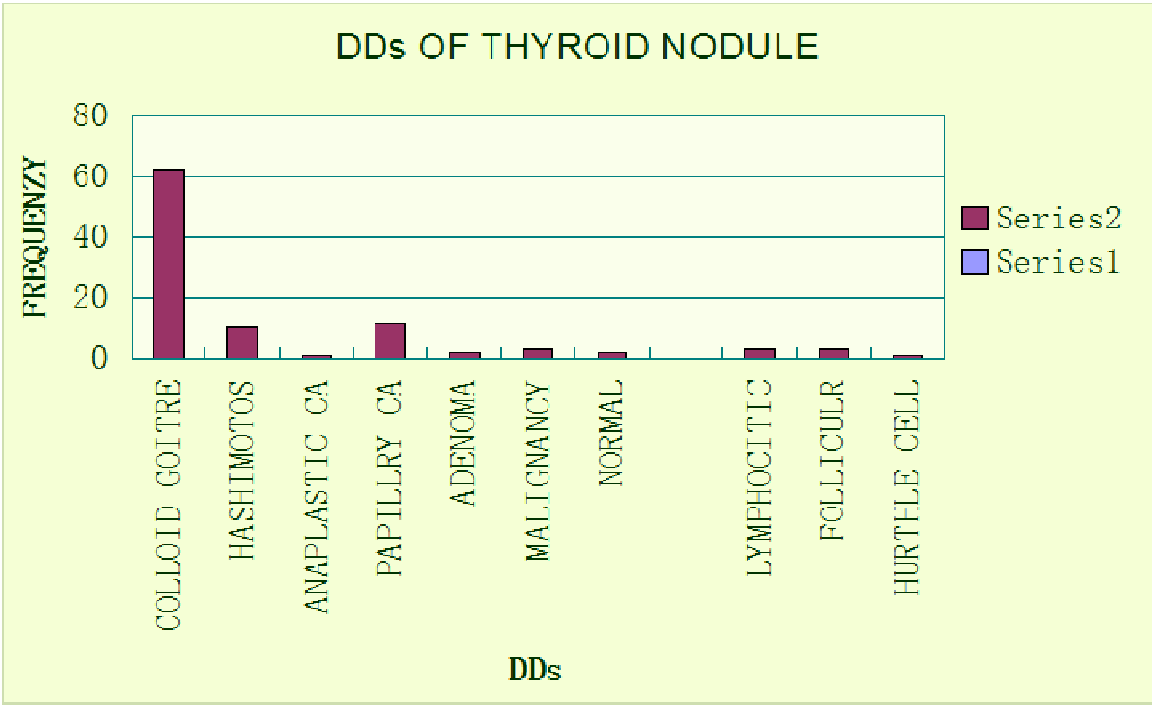
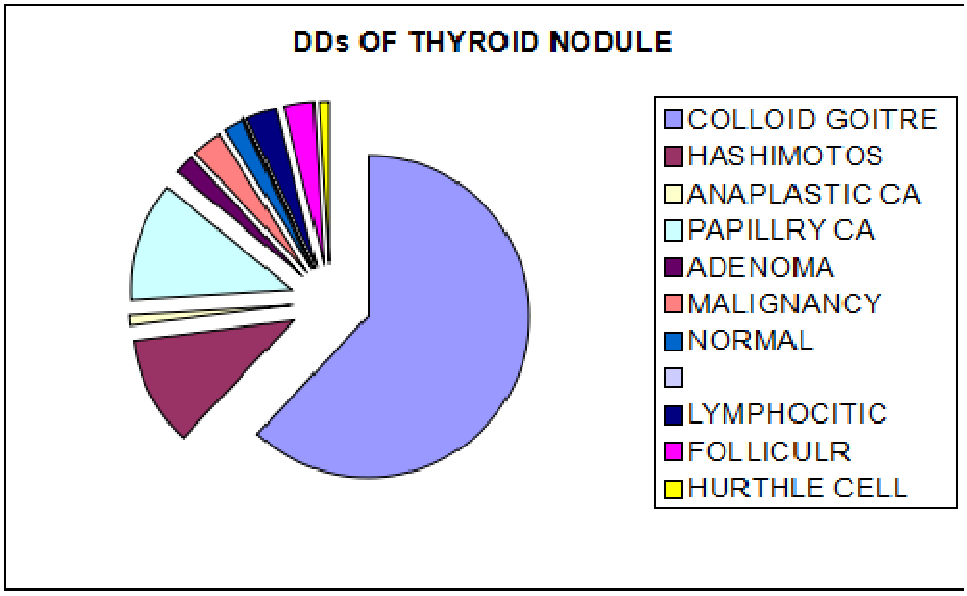


Fig.27. Pie chart showing differential diagnosis of thyroid swellings



Majority of the thyroid swellings were found to be colloid goitre,which constituted 62 patients of the total 100 studied. 12 cases of papillary carcinoma, 11 Hashimotos thyroiditis, 4 follicular neoplasms, 3 each of lymphocytic thyroiditis and non specified malignancy, 2 cases of adenomatous goitre and normal thyroid gland and1 case of anaplastic carcinoma were the other pathologies noted.

MALIGNANCY IN THYROID SWELLINGS

Table 5.Distribution of malignancy

	ANAPLASTIC	PAPILLARY	FOLICULAR	NOT SPECIFIED	TOTAL
FREQUENZY	1	12	4	3	20

Fig. 28. Bar diagram showing Distribution of malignancy

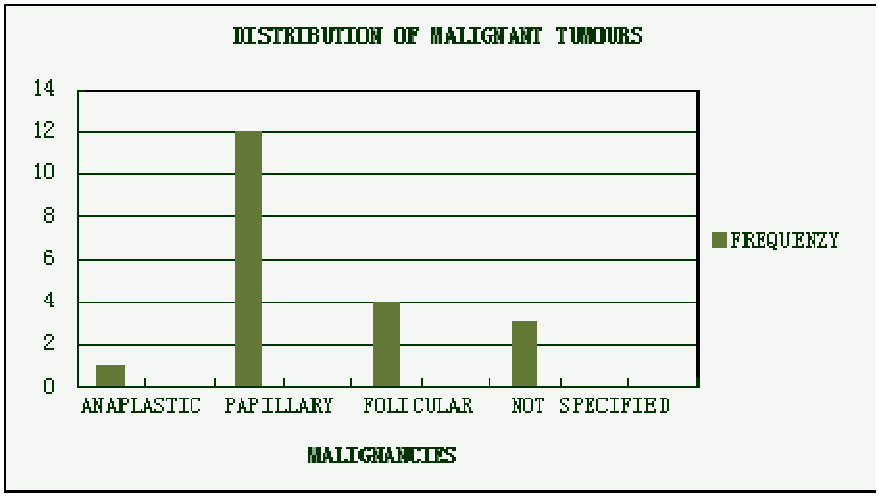
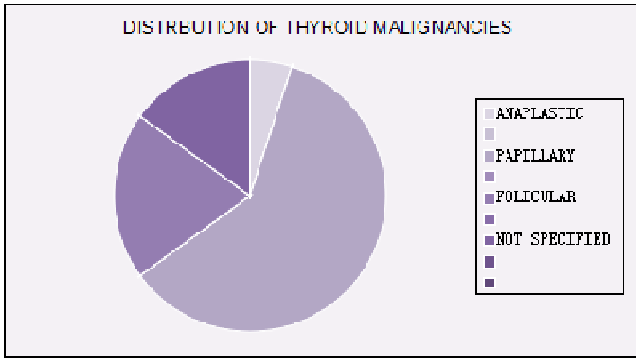


Fig. 29. Pie chart showing Distribution of malignancy



Of all the malignancies papillary carcinoma constitutes 60%, follicular neoplasm 20%, not specified malignancy 15% and anaplastic carcinoma 5%.

AGE DISTRIBUTION IN DIFFERENTIAL DIGNOSIS

Table 6 .Age distribution in differential diagnosis

AGE	COLLOID GOITRE	HASHIMOTOS	ANAPLASTIC CA	PAPILLRY CA	ADENOMA	MALIGNANCY	NORMAL	LYMPHOCITIC	FOLLICULR	HURTHLE CELL	TOTAL
10 - 20y											
20 - 30		3		1							
30 - 40	24	1		4					2		
40 - 50	19	2				2	2	3	1		
50 - 60	13	3		3							
60 - 70	5	2	1		2	1					
70 - 80	1			4						1	
TOTAL	62	11	1	12	2	3	2	3	3	1	100

Fig.30. Bar diagram showing Age distribution in differential diagnosis

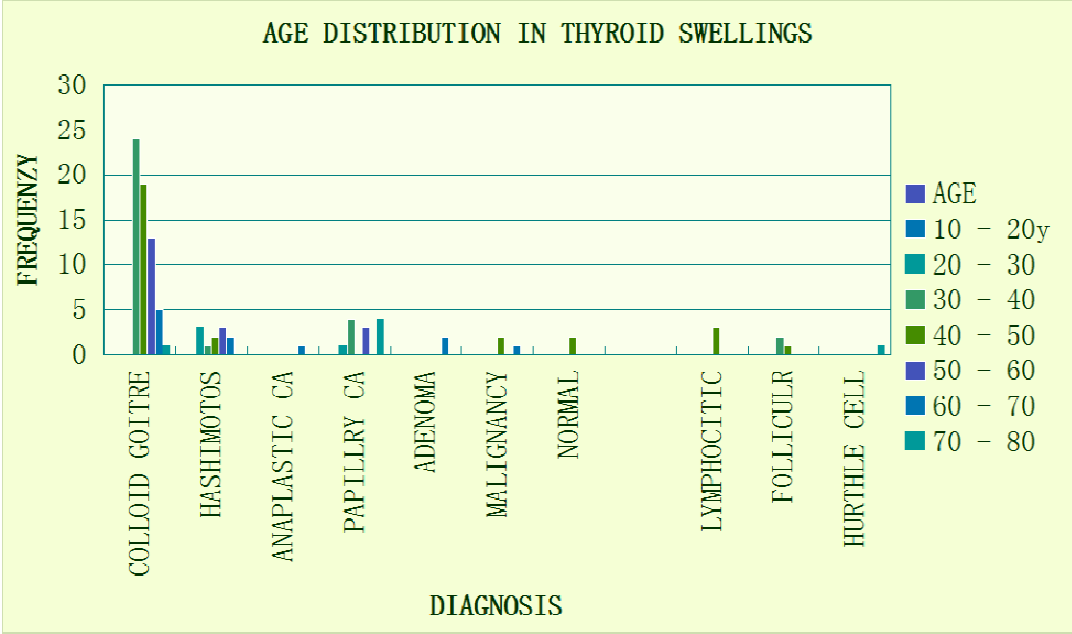
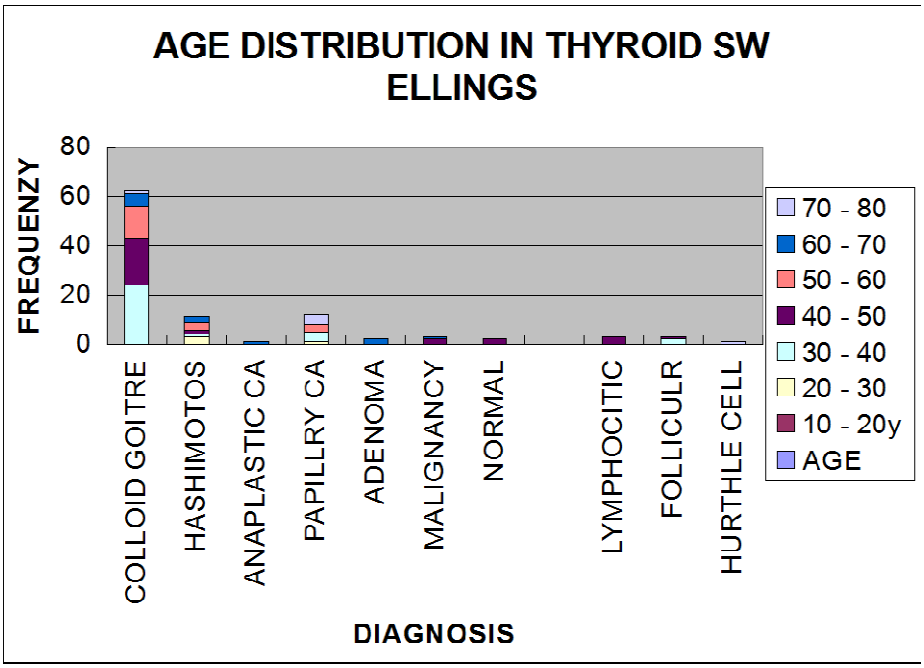


Fig.31. Component Bar diagram showing Age distribution in differential diagnosis



Benign disorders mainly affected the fourth and fifth decade of life, but for malignancy there we found an increased incidence in the fourth decade and also above 65 years.

TIRADS CLASSIFICATION

Table 7.Distribution in TIRADS scoring system

	1	2	3	4a	4b	4c	5	6	TOTAL
FREQUENCY	2	11	6	16	40	15	10		100

Fig. 32. Bar diagram showing Distribution in TIRADS scoring system

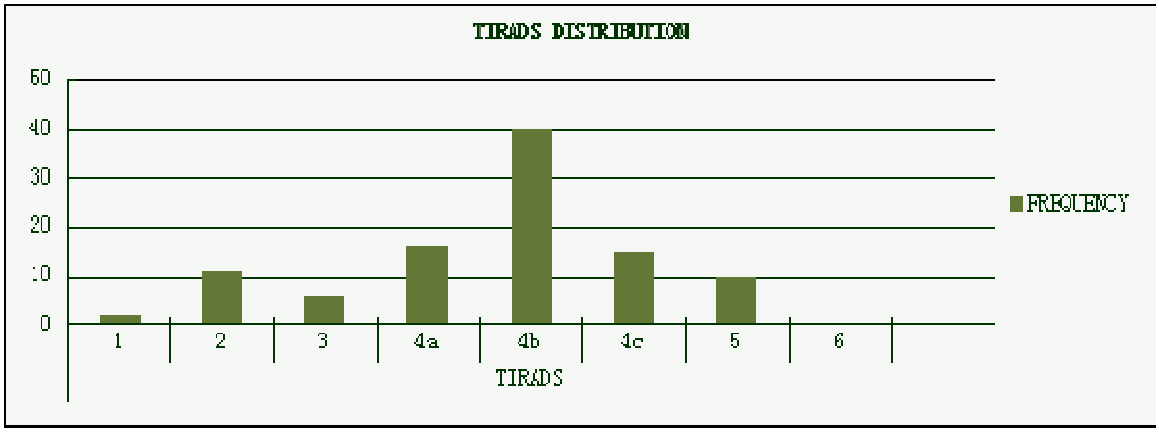
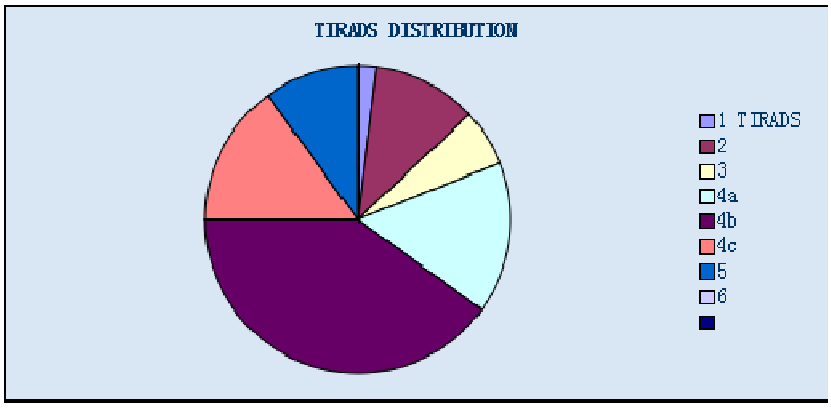


Fig.33. Pie chart showing Distribution in TIRADS scoring system



The 100 cases were grouped into various classes of TIRADS. TIRADS 1 - 2%; TIRADS 2 - 11%; TIRADS 3 - 6%; TIRADS 4 - 71%; TIRADS 5 - 10%.

MALIGNANCY DISTRIBUTION IN TIRADS CLASSES

Table 8.Malignancy distribution in TIRADS scoring system

TIRADS	BENIGN	MALIGNANT
1	100	0
2	100	0
3	100	0
4a	100	0
4b	92.5	7.5
4c	60	40
5	0	100

Fig 34. Area chart showing Malignancy distribution in TIRADS system

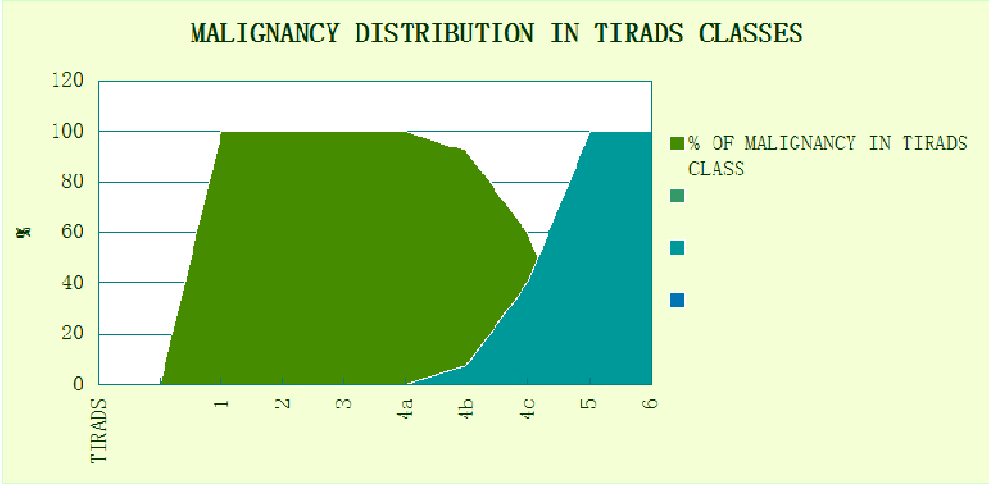


Fig 35.Line diagram showing Malignancy distribution in TIRADS system

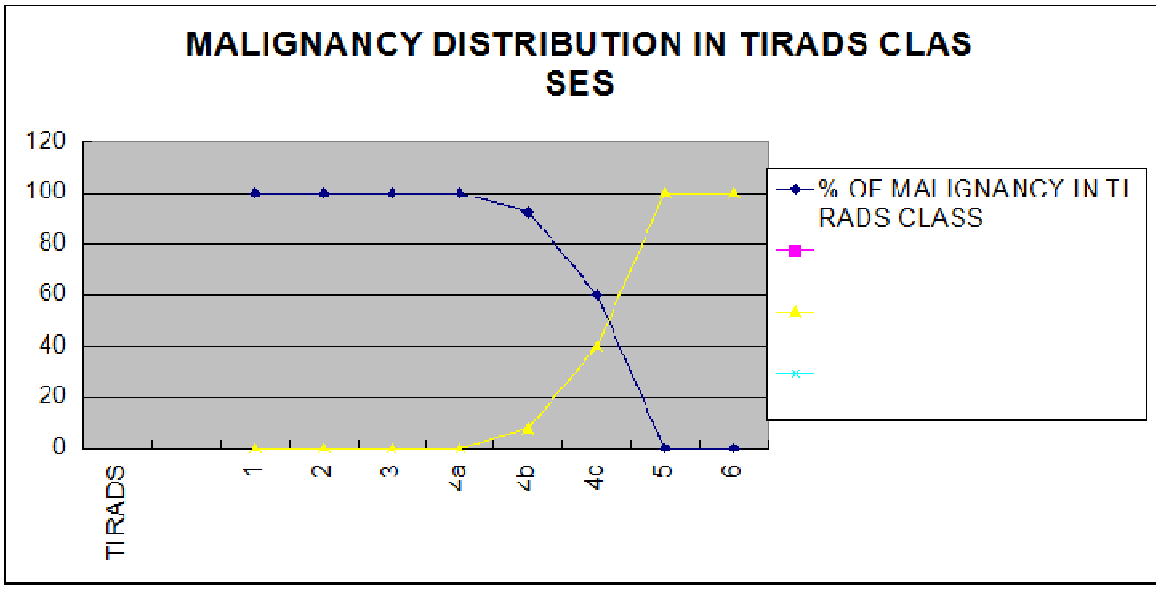


Table.9. Malignancy distribution in 4b

	BENIGN	MALIGNANT	TOTAL
4b	**37**	**3**	**40**

Fig 36. Bar diagram showing Malignancy distribution in 4b

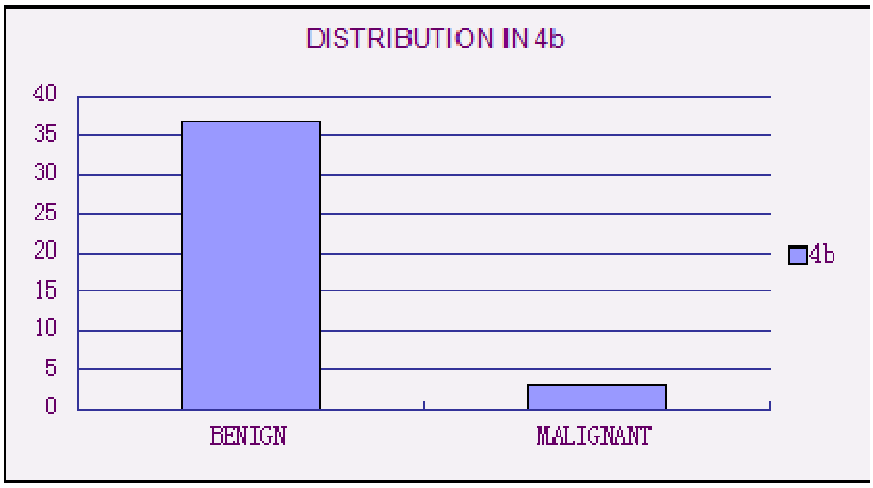


Fig.37. Pie chart showing Malignancy distribution in 4b

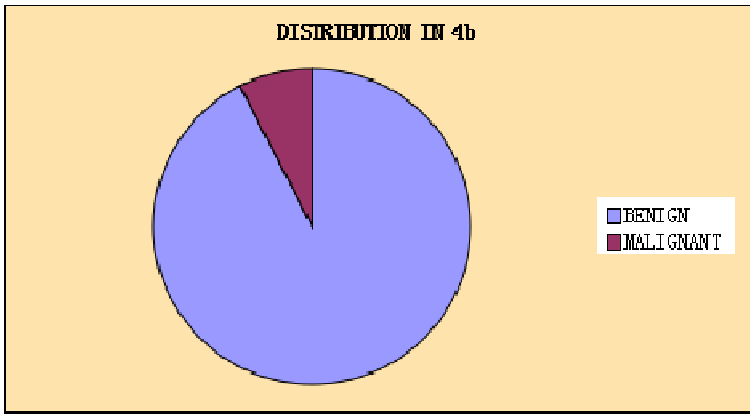


Table 10.Malignancy distribution in 4c

	BENIGN	MALIGNANT	TOTAL
4c	9	6	15

Fig.38. Bar diagram showing Malignancy distribution in 4c

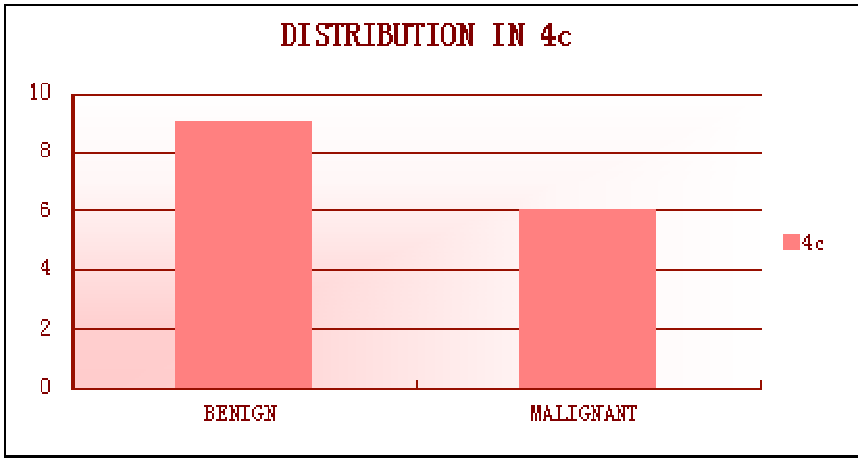
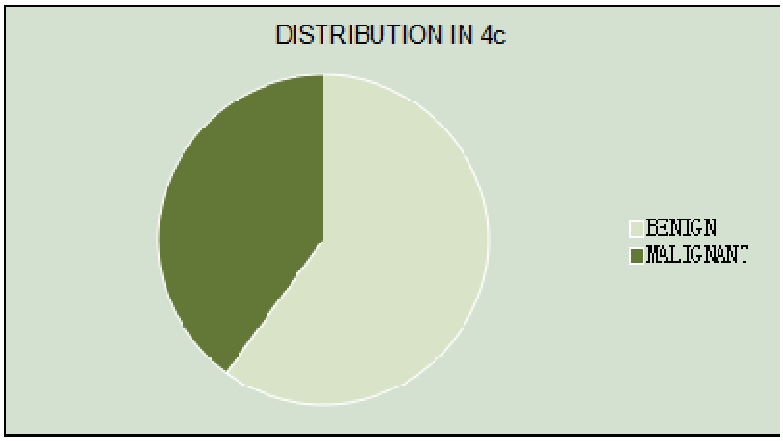


Fig 39. Pie chart showing Malignancy distribution in 4c



Malignant nodules first appeared in TIRADS 4b with incidence of 7.5%. TIRADS 4c showed an incidence of 40% which rose to 100% in TIRADS.

COMPARISON OF TIRADS, FNAC AND HPE

Of the 100 cases studied,FNAC correlated with 96 cases. Only 4 cases showed different diagnosis. All the 4 cases belonged to TIRADS class 4c. 2 cases where FNAC showed adenomatous goitre were found to be papillary carcinoma and follicular carcinoma each.

1 case of colloid goitre in FNAC was found to be papillary carcinoma on biopsy.

1 case of Hashimotos thyroiditis proved to be papillary carcinoma in biopsy.

All the 4 cases were grouped under TIRADS 4c (suspicious lesion with 3 or 4 suspicious sonographic features.)

So, of the 15 cases in TIRADS 4c,10 cases became malignant and 5 cases benign as per HPE.So percentage of malignancy in TIRADS 4c is 66.7% and 33.3% benign lesion.

SIGNIFICANCE OF HIGH RISK SONOGRAPHIC FEATURES

1.SOLID COMPONENTS

Table 11.2 * 2 Table showing significance of solid components

SOLID COMPONENTS	MALIGNANCY		TOTAL
	YES	NO	
YES	20	61	81
NO	0	14	14
TOTAL	20	75	95

1	SENSITIVITY	20/20*100	100
2	SPECIFICITY	14/75*100	18.7
3	POSITIVE PREDICTIVE VALUE	20/81*100	24.7
4	NEGETIVE PREDICTIVE VALUE	14/14*100	100
5	ACCURACY	34/95*100	35.8

Table 12.2 * 2 Table showing significance of hypoechogenicity

HYPOECHOGENICITY	MALIGNANCY		TOTAL
	YES	NO	
YES	20	53	73
NO	0	19	19
TOTAL	20	72	92

1	SENSITIVITY	20/20*100	100
2	SPECIFICITY	19/72*100	26.4
3	POSITIVE PREDICTIVE VALUE	20/73*100	27.4
4	NEGETIVE PREDICTIVE VALUE	19/19*100	100
5	ACCURACY	39/92*100	42.4

Table 13.2 * 2 Table showing significance of micro calcification

MICROCAL CIFICATION	MALIGNANCY		TOTAL
	YES	NO	
YES	15	6	21
NO	5	63	68
TOTAL	20	69	89

1	SENSITIVITY	15/20*100	75
2	SPECIFICITY	63/69*100	91.3
3	POSITIVE PREDICTIVE VALUE	15/21*100	71.4
4	NEGETIVE PREDICTIVE VALUE	63/68*100	92.65
5	ACCURACY	78/89*100	87.6

Table 14.2 * 2 Table showing significance of taller than wider

TALLER THAN WIDER	MALIGNANCY		TOTAL
	YES	NO	
YES	12	4	16
NO	8	65	73
TOTAL	20	69	89

1	SENSITIVITY	12/20*100	60
2	SPECIFICITY	65/69*100	94.2
3	POSITIVE PREDICTIVE VALUE	12/16*100	75
4	NEGETIVE PREDICTIVE VALUE	65/73*100	89
5	ACCURACY	77/89*100	86.5

Table 15. 2 * 2 Table showing significance of irregular margins

IRREGULAR MARGINS	MALIGNANCY		TOTAL
	YES	NO	
YES	16	4	20
NO	4	65	69
TOTAL	20	69	89

1	SENSITIVITY	16/20*100	80
2	SPECIFICITY	65/69*100	94.2
3	POSITIVE PREDICTIVE VALUE	16/20*100	80
4	NEGETIVE PREDICTIVE VALUE	65/69*100	94.2
5	ACCURACY	81/89*100	91

DISCUSSION

Thyroid swellings were seen to affect mainly females within the age group of 30-40 years in the above series. Female to male ratio was found to be 13.2:1. 20% of the cases were found to have malignancy, of which papillary carcinoma accounted for 60%, follicular neoplasm 20%, not specified malignancy 15% and anaplastic carcinoma 5%. When classified into TIRADS, majority of them fell into TIRADS 4 (71%). TIRADS 4b showed incidence of malignancy of 7.5%, TIRADS 4c - 66.7%, TIRADS 5 - 100%. Study by Horvath et al showed malignancy rate in TIRADS 3 - <5%; TIRADS 4a- 5-10%; TIRADS 4b - 10-80%; TIRADS 4c - >80%. The suspicious sonographic features were evaluated. Solid components and hypoechogenicity were found to be maximum sensitive but less specific. Sensitivity, specificity ,positive predictive value,negative predictive value were found to be maximum for irregular margins (80, 94.2, 80, 94.2, 91 resp.).

Significance of suspicious sonographic features

PARAMETER	SENSITIVITY	SPECIFICITY	POSITIVE PREDICTIVE VALUE	NEGETIVE PREDICTIVE VALUE	ACCURACY
SOLID COMPONENTS	100	18.7	23.8	100	35.1
HYPOECHOGENICITY	100	26.4	26.4	100	41.8
MICROCALCIFICATION	79	91.4	71.4	94	68.2
TALLER THAN WIDER	63.2	94.2	75	90.3	87.5
IRREGULAR MARGINS	84.2	94.2	80	95.6	92

Study by Frates, Benson, Charboneau

PARAMETER	SENSITIVITY	SPECIFICITY	POSITIVE PREDICTIVE VALUE	NEGETIVE PREDICTIVE VALUE
SOLID COMPONENTS	69-75	53-56	16-27	88-92
HYPOECHOGENICITY	27-87	43-94	11-- 68	74-94
MICROCALCIFICATION	26-59	86-95	24-71	42-94
TALLER THAN WIDER	33	93	67	75
IRREGULAR MARGINS	17-78	39-85	9--60	39-98

CONCLUSION

1. ULTRASOUD THYROID PLAYS A MAJOR ROLE IN THE EVALUATION OF THYROID SWELLINGS AS IT PROVIDES SUSPICIOUS SONOLGRAPHIC FEATURES TO CLASSIFY PATIENT INTO HIGH RISK. FURTHER WHEN ULTRASOUND GUIDED FNAC IS USED, IT ENHANCES THE DIAGNOSTIC OUTCOME.
2. TIRADS CLASSIFICATION CAN STANDARDISE THE ULTRASOUND FINDINGS SO AS TO SELECT AT RISK PATIENTS REQUIRING DETAILED EVALUATION.
3. TIRADS 4b INCLUDED MAXIMUM CASES WITH 7.5% MALIGNANT CHANCES. TIRADS 4c SHOWED 66.7% MALIGNANCY AND TIRADS 5 SHOED 100% MALIGNANCY.
4. THE SIGNIFICANCE OF VARIOUS SUSPICIOUS SONOGRAPHIC FEATURES STUDIED SHOWED IRREGULAR MARGIN AS MOST ACCURATE FEATURE SUGGESTIVE OF MALIGNANCY. TALLER THAN WIDER AND MICROCALCIFICATIONS ALSO HAVE HIGH CHANCE OF MALIGNANCY WHEN COMPARED TO SOLID COMPONENTS AND HYPOECHOGENICITY.

5. ULTRASOUND IS SIMPLE, SAFE, QUICK AND NONINVASIVE. IT SHOULD BE EXPLOITED TO ITS MAXIMUM BENEFIT FOR ALL THYROID SWELLINGS.

SUMMARY

100 patients were studied from January 2014 to June 2015.

The TIRADS Class was compared with the cytological diagnosis in these cases.

Majority of thyroid cases (58%) were in the 4 thand 5th decades of life (31-50) yrs, 93 were females and 7 were males,

Females : Males = 13.2 : 1

Of the 100 cases 80 were benign and 20 malignant. Papillary carcinoma was the most common malignancy (60%) , follicular - 20% , nonspecified malignancy 15% , anaplastic - 5%.

Incidence of malignancy in TIRADS 4a was 0%, TIRADS 4b - 7.5% , TIRADS 4c - 66.7% , TIRADS 5 - 100%.

Sensitivity, specificity, positive predictive value, negetive predictive value and accuracy, respectively, for each of the suspicious sonographic features were :

1.solid components : 100, 18.7, 24.7, 100, 35.8

2.Hypoechogenicity : 100, 26.4, 27.4, 100, 42.4

3.Microcalcification : 75, 91.3, 71.4, 92.7, 87.6

4.Taller than wider : 60, 94.2, 75, 89, 86.5

5.Irregular margins : 80, 94.2, 80, 94.2, 91

LIMITATIONS OF STUDY

The study sample selected is not a representative of the general population. Therefore the true incidence of various thyroid pathologies couldnot be assessed..

The number of malignant cases studied during this limited period was not sufficient enough to make concrete conclusions, as regard to the sensitivity, specificity and accuracy of various sonographic features.

The experience of the Radiologist is an important factor affecting the outcome of the study.

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PROFORMA

Name :

Age : Sex : IP.No. :

History :

Thyroid function tests :

USG :

TIRADS class :

Clinical diagnosis :

FNAC Report :

STATISTICAL METHODS APPLIED

The following statistical methods were applied in the present study

1. Cross tabs procedure
2. Descriptive statistics
3. Sensitivity
4. Specificity
5. Positive predictive value
6. Negative predictive value
7. Accuracy

Cross tabs Procedure

The cross tabs procedure forms two way and multi way tables and provides a variety of tests and measures of association for two-way tables. The structure of the table and whether categories are ordered determine what test or measure to use.

Cross tabs statistics and measures of association are computed for two way tables only.

Descriptive statistics

This provides summary, information about the distribution, variability and central tendency of a variable.

Sensitivity

It is computed as follows Sensitivity $= \frac{TP \times 100}{TP + FN}$

Specificity

It is computed as follows Specificity $= \frac{TN \times 100}{TN + FP}$

Positive predictive value

It is computed as follows Positive predictive

$$\text{value} = \frac{TP \times 100}{TP + FP}$$

Negative predictive value

It is computed as follows Negative predictive

$$\text{value} = \frac{TN \times 100}{TN + FN}$$

Accuracy

It is computed as follows

$$\text{ACCURACY} = \frac{TP + TN}{TP+TN+FP+FN} * 100$$

Where TP,TN,FP and FN imply True Positive, True Negative, False Positive and False Negative respectively.

MASTER CHART

NAME	AGE	SEX	IP NO:	BIOCHEMICAL STATUS	NODULARITY	SOLID COMPONENTS	HYPOECHOGENICITY	MICROCALCIFICATION	TALLER THAN WIDE	IRREGULAR MARGINS	TIRADS	FNAC (HPE)
SARASWATHY	42	F	72478	HYPER	Y	Y	Y	N	N	N	4b	COLLOID GOITRE
LAKSHMI	34	F	807	EU	Y	Y	Y	N	N	N	4b	COLLOID GOITRE
MAHALAKSHMI	29	F	1086	HYPO	N	N	Y	N	N	N	2	HASHIMOTOS
MEENA	34	F	3867	EU	Y	Y	Y	N	N	N	4b	COLLOID GOITRE
MARIAMMAL	30	F	4120	EU	Y	Y	Y	N	N	N	4b	COLLOID GOITRE
THANGAM	69	F	4388	EU	Y	Y	Y	Y	Y	Y	5	ANAPLATIC CA
ANBUJAM	55	F	3555	EU	Y	Y	N	N	N	N	4a	COLLOID GOITRE
KALAVATHY	34	F	6252	EU	Y	Y	Y	Y	Y	Y	5	PAPILLARY CA
SHANTHI	40	F	4764	EU	Y	Y	Y	N	N	Y	4c	MALIGNANCY
ANNALREENA	35	F	983	EU	Y	Y	Y	Y	N	N	4c	COLLOID GOITRE (PAPILLARY CARCINMA)
VAIGUNDA MANI	60	F	24014	EU	Y	Y	Y	Y	N	Y	4c	ADENOMA (PAPILLARY CARCINOMA)
ULAGAMMAL	37	F	74877	EU	Y	N	Y	N	N	N	4a	COLLOID GOITRE
AVUDIAMMAL	60	F	14849	EU	Y	Y	N	N	N	N	4a	COLLOID GOITRE
JOYAL	32	F	18005	EU	Y	Y	Y	N	Y	N	4c	COLLOID GOITRE
CHERMAKANI	45	F	18934	EU	Y	N	Y	N	N	N	4a	COLLOID GOITRE
ADHISAYAMANI	40	F	43328	EU	Y	Y	N	N	Y	N	4b	COLLOID GOITRE
NAGOORFATIMA	70	F	18688	EU	Y	Y	N	N	N	N	4a	COLLOID GOITRE

MURUGANATHN	**43**	**M**	**17702**	**HYPER**	**Y**	**Y**	**Y**	**N**	**N**	**N**	**4b**	**COLLOID GOITRE**
PARVATHY	**52**	**F**	**18708**	**EU**	**Y**	**Y**	**Y**	**Y**	**Y**	**N**	**4c**	**PAPILLARY CA**
SAMUTHRAKANI	**36**	**F**	**20668**	**EU**	**Y**	**Y**	**N**	**N**	**N**	**N**	**4a**	**COLLOID GOITRE**
MARIAMMAL	**63**	**F**	**19282**	**EU**	**Y**	**N**	**Y**	**N**	**N**	**N**	**4a**	**COLLOID GOITRE**
SARASWATHI	**52**	**F**	**19474**	**HYPER**	**Y**	**N**	**N**	**N**	**N**	**N**	**3**	**COLLOID GOITRE**
ALAGAR	**35**	**F**	**20907**	**EU**	**Y**	**N**	**N**	**N**	**N**	**N**	**3**	**COLLOID GOITRE**
VIJAYARANI	**37**	**F**	**20893**	**EU**	**Y**	**N**	**N**	**N**	**N**	**N**	**3**	**COLLOID GOITRE**
SELVI	**51**	**F**	**22959**	**EU**	**Y**	**Y**	**Y**	**N**	**N**	**N**	**4b**	**COLLOID GOITRE**
RAMAIAH	**75**	**M**	**20690**	**EU**	**Y**	**Y**	**Y**	**Y**	**N**	**Y**	**4c**	**PAPILLARY CA**
RAMALAKSHMI	**40**	**F**	**206703**	**EU**	**Y**	**Y**	**Y**	**N**	**N**	**N**	**4b**	**COLLOID GOITRE**
MARAMANI	**38**	**F**	**26645**	**HYPER**	**Y**	**Y**	**Y**	**N**	**N**	**N**	**4b**	**COLLOID GOITRE**
THEVANAI	**65**	**F**	**21871**	**EU**	**Y**	**Y**	**Y**	**Y**	**N**	**Y**	**4c**	**HASHIMOTOS**
SIKANDERBEEVI	**48**	**F**	**27715**	**EU**	**Y**	**Y**	**Y**	**N**	**N**	**N**	**4b**	**COLLOID GOITRE**
KALYANI	**55**	**F**	**27306**	**EU**	**Y**	**Y**	**Y**	**N**	**N**	**N**	**4b**	**COLLOID GOITRE**
MURUGAMMAL	**40**	**F**	**27061**	**EU**	**N**						**1**	**NORMAL**
ULAGUMUTHU	**50**	**F**	**27821**	**EU**	**Y**	**Y**	**Y**	**N**	**Y**	**N**	**4c**	**COLLOID GOITRE**
SIVANAMMAL	**30**	**F**	**30765**	**EU**	**Y**	**Y**	**Y**	**Y**	**N**	**N**	**4c**	**COLLOID GOITRE**
KOKILA	**26**	**F**	**28140**	**EU**	**N**						**2**	**HASHIMOTS**
RAMALAKSHMI	**40**	**F**	**26703**	**SC HYPO**	**Y**	**Y**	**N**	**N**	**N**	**N**	**4a**	**COLLOID GOITRE**
LAKSHMI	**46**	**F**	**31331**	**EU**	**N**	**Y**	**Y**				**2**	**LYMPHOCYTIC THYROIDITIS**
ULAGUMATHA	**50**	**F**	**29176**	**EU**	**N**						**2**	**HASHIMOTS**
KUMARI	**36**	**F**	**28900**	**EU**	**Y**	**Y**	**Y**	**N**	**N**	**N**	**4b**	**COLLOID GOITRE**
JAYANTHI	**36**	**F**	**37183**	**EU**	**Y**	**Y**	**Y**	**N**	**N**	**N**	**4b**	**COLLOID GOITRE**
MUTHUSELVI	**30**	**F**	**37651**	**EU**	**Y**	**Y**	**Y**	**N**	**N**	**N**	**4b**	**FOLLICULAR**

												ADENOMA
PALAVESAM	54	F	37442	EU	Y	Y	Y	N	N	N	4b	COLLOID GOITRE
PARVATHY	50	F	E	N	Y	Y					2	HASHIMOTOS
THANGAM	36	F	42030	EU	Y	Y	Y	N	N	N	4b	COLLOID GOITRE
ESAKKIAMMAL	40	F	42257	EU	N	Y					2	HASHIMOTOS
AMMAPONNU	70	F	41009	EU	Y	Y	Y	N	Y	Y	4c	HURTHLE CELL NEOPLASM
ANNAL	37	F	43045	EU	Y	Y	Y	Y	Y	Y	5	PAPILLARY CA
ANTONYAMMAL	65	F	37133	EU	Y	Y	Y	N	N	N	4b	COLLOID GOITRE
HAMARNIS	40	F	97141	HYPER	Y	Y	Y	N	N	N	4b	COLLOID GOITRE
JEYAPANDI	40	M	43674	EU	N						2	HASHIMOTOS
POOLKOTHAI	47	F	48288	EU	Y	Y	Y	N	N	N	4b	COLLOID GOITRE
SOORYAKALA	41	F	48846	EU	Y	Y	Y	N	N	N	4b	COLLOID GOITRE
SUGUNA	31	F	37896	EU	Y	Y	Y	Y	N	Y	4c	PAPILLARY CA
PETCHIAMMAL	62	F	28018	EU	Y	Y	Y	Y	N	Y	4c	ADENOMA (FOLLICULAR CARCINOMA)
MARIAMMAL	32	F	28861	EU	Y	N	Y	N	N	N	4a	COLLOID GOITRE
ULAGAMMAL	58	F	24849	EU	Y	Y	N	N	N	N	4a	COLLOID GOITRE
CHELLAMMAL	27	F	41562	SC HYPO	Y	Y	Y	Y	N	Y	4c	PAPILLARY CA
AVUDIAMMAL	36	F	18086	Y	Y	Y	N	N	N	N	4b	COLLOID GOITRE
JOYAL	44	F	28934	SC HYPO	Y	N	Y	N	N	N	4a	COLLOID GOITRE
CHERMAKANI	40	F	23328	EU	Y	Y	N	N	Y	N	4b	COLLOID GOITRE
ADHISAYAMANI	42	F	43348	EU	Y	Y	N	N	N	N	4a	COLLOID GOITRE
NAGOORFAHIMA	68	F	18738	EU	Y	Y	N	N	N	N	4a	COLLOID GOITRE
MURUGANATHN	42	M	17808	EU	Y	Y	Y	N	N	N	4b	COLLOID GOITRE

PARVATHY	**50**	**F**	**19808**	**EU**	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**	**5**	**PAPILLARY CA**
MARIKODI	**36**	**F**	**20672**	**EU**	**Y**	**Y**	**N**	**N**	**N**	**N**	**4a**	**COLLOID GOITRE**
MARIAMMAL	**62**	**F**	**19268**	**EU**	**Y**	**N**	**Y**	**N**	**N**	**N**	**4a**	**COLLOID GOITRE**
MURUGANATHN	**53**	**M**	**19806**	**EU**	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**	**5**	**PAPILLARY CA**
SARASWATHI	**52**	**F**	**19482**	**HYPER**	**Y**	**N**	**N**	**N**	**N**	**N**	**3**	**COLLOID GOITRE**
NAGALAKSHMI	**51**	**F**	**28086**	**EU**	**Y**	**N**	**N**	**N**	**N**	**N**	**3**	**COLLOID GOITRE**
ALAGAR	**36**	**F**	**20908**	**EU**	**Y**	**N**	**N**	**N**	**N**	**N**	**3**	**COLLOID GOITRE**
SELVI	**51**	**F**	**23986**	**EU**	**Y**	**Y**	**Y**	**N**	**N**	**N**	**4b**	**COLLOID GOITRE**
RAMU	**75**	**M**	**20690**	**EU**	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**	**5**	**PAPILLARY CA**
RAMALAKSHMI	**40**	**F**	**26802**	**EU**	**Y**	**Y**	**Y**	**N**	**N**	**N**	**4b**	**COLLOID GOITRE**
LAHSHMI	**36**	**F**	**26845**	**EU**	**Y**	**Y**	**Y**	**N**	**N**	**N**	**4b**	**COLLOID GOITRE**
SUDALAI	**76**	**M**	**20890**	**EU**	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**	**5**	**PAPILLARY CA**
DEVANAI	**65**	**F**	**21986**	**HYPO**	**Y**	**Y**	**Y**	**Y**	**N**	**Y**	**4c**	**HASHIMOTS(PAPILLARY CARCINOMA)**
REVATHY	**48**	**F**	**28826**	**EU**	**Y**	**Y**	**Y**	**N**	**N**	**N**	**4b**	**COLLOID GOITRE**
MURUGAMMAL	**42**	**F**	**28082**	**EU**	**N**	**Y**					**1**	**NORMAL**
ULAGAMMAL	**52**	**F**	**28821**	**EU**	**Y**	**Y**	**Y**	**N**	**N**	**N**	**4b**	**COLLOID GOITRE**
SIVANAMMAL	**30**	**F**	**30786**	**EU**	**Y**	**Y**	**Y**	**N**	**N**	**N**	**4b**	**COLLOID GOITRE**
KAVITHA	**28**	**F**	**28186**	**EU**	**N**						**2**	**HASHIMOTOS**
RAMALAKSHMI	**40**	**F**	**26786**	**SC HYPER**	**Y**	**Y**	**N**	**N**	**N**	**N**	**4a**	**COLLOID GOITRE**
LALITHA	**46**	**F**	**33138**	**EU**	**Y**	**Y**	**Y**	**N**	**N**	**N**	**4b**	**LYMPHOCYTIC THYROIDITIS**
ALAGAMMAL	**52**	**F**	**29188**	**EU**	**N**						**2**	**HASHIMOTOS**
AMRITALAKSHMI	**44**	**F**	**31868**	**EU**	**N**	**Y**	**Y**				**2**	**LYMPHOCYTIC THYROIDITIS**

RAMAKUMARI	**37**	**F**	**38900**	**EU**	**Y**	**Y**	**Y**	**N**	**N**	**N**	**4b**	**COLLOID GOITRE**
JEYALALITHA	**35**	**F**	**36183**	**EU**	**Y**	**Y**	**Y**	**N**	**N**	**N**	**4b**	**COLLOID GOITRE**
SELVI	**32**	**F**	**37651**	**EU**	**Y**	**Y**	**Y**	**N**	**N**	**N**	**4b**	**FOLLICULAR ADENOMA**
PALAVESAM	**38**	**F**	**38623**	**EU**	**Y**	**Y**	**Y**	**N**	**N**	**N**	**4b**	**FOLLICULAR ADENOMA**
BHARATHI	**55**	**F**	**38612**	**EU**	**Y**	**Y**	**Y**	**N**	**N**	**N**	**4b**	**COLLOID GOITRE**
SIVANAMMAL	**40**	**F**	**37868**	**HYPER**	**Y**	**Y**	**Y**	**N**	**N**	**N**	**4b**	**COLLOID GOITRE**
SETHULAKSHMI	**32**	**F**	**28035**	**EU**	**Y**	**Y**	**Y**	**N**	**N**	**N**	**4b**	**COLLOID GOITRE**
MAHALAKSHMI	**30**	**F**	**10808**	**HYPO**	**N**	**Y**	**Y**				**2**	**HASHIMOTS**
MEENA	**32**	**F**	**38678**	**EU**	**Y**	**Y**	**Y**	**N**	**N**	**N**	**4b**	**COLLOID GOITRE**
MARIKODI	**30**	**F**	**41868**	**EU**	**Y**	**Y**	**Y**	**N**	**N**	**N**	**4b**	**COLLOID GOITRE**
THANGAMARI	**68**	**F**	**43861**	**EU**	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**	**5**	**MALIGNANCY**
AMUTHA	**55**	**F**	**35550**	**EU**	**Y**	**Y**	**Y**	**N**	**N**	**N**	**4b**	**COLLOID GOITRE**
KALA	**32**	**F**	**27836**	**EU**	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**	**5**	**PAPILLARY CA**
SANTHA	**42**	**F**	**47684**	**EU**	**Y**	**Y**	**Y**	**Y**	**N**	**Y**	**4c**	**MALIGNANCY**
SHEELA	**70**	**F**	**28692**	**EU**	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**	**5**	**PAPILLARY CA**